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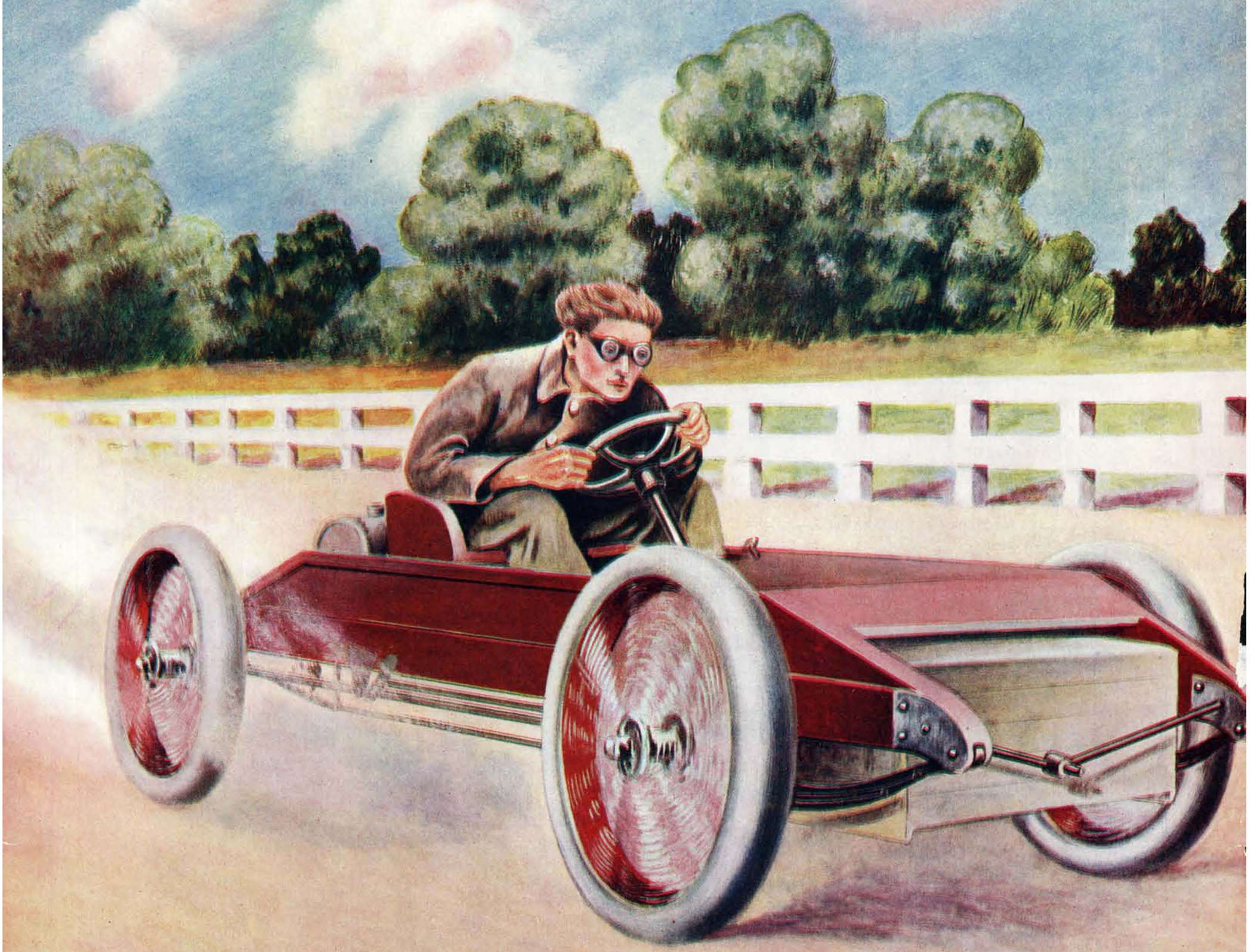

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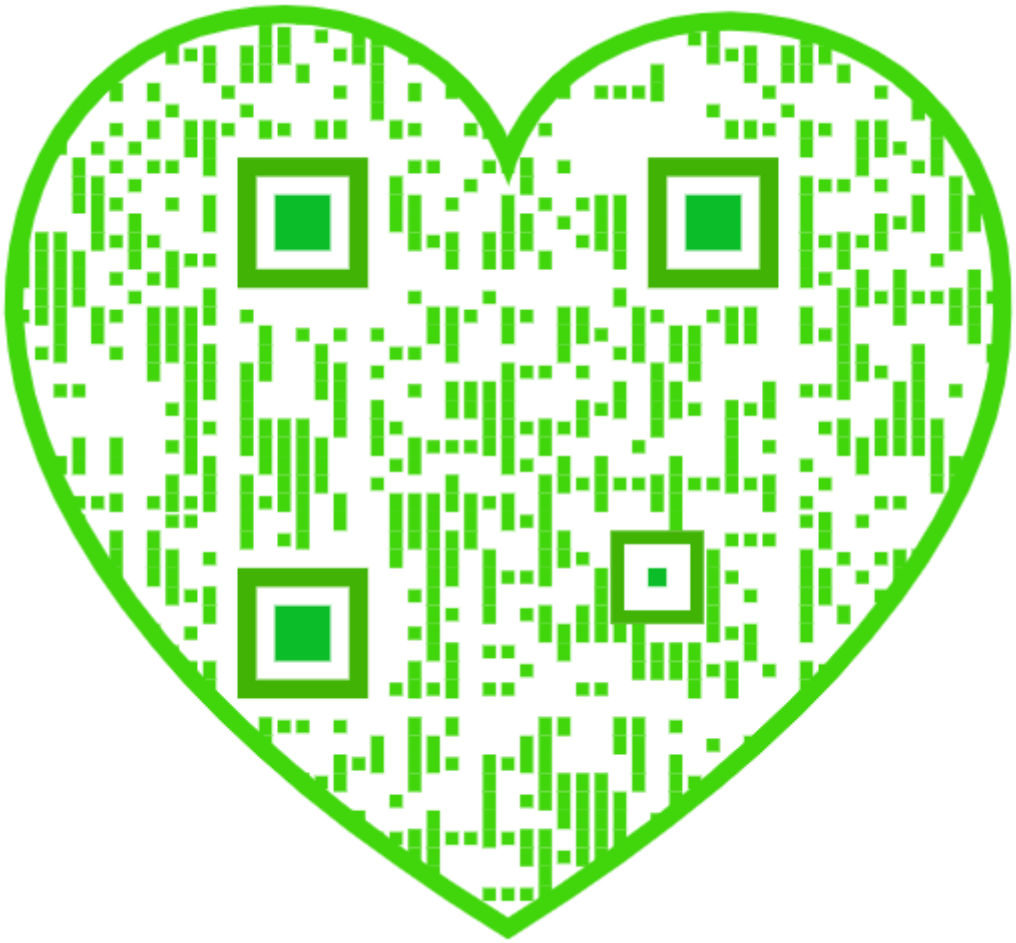

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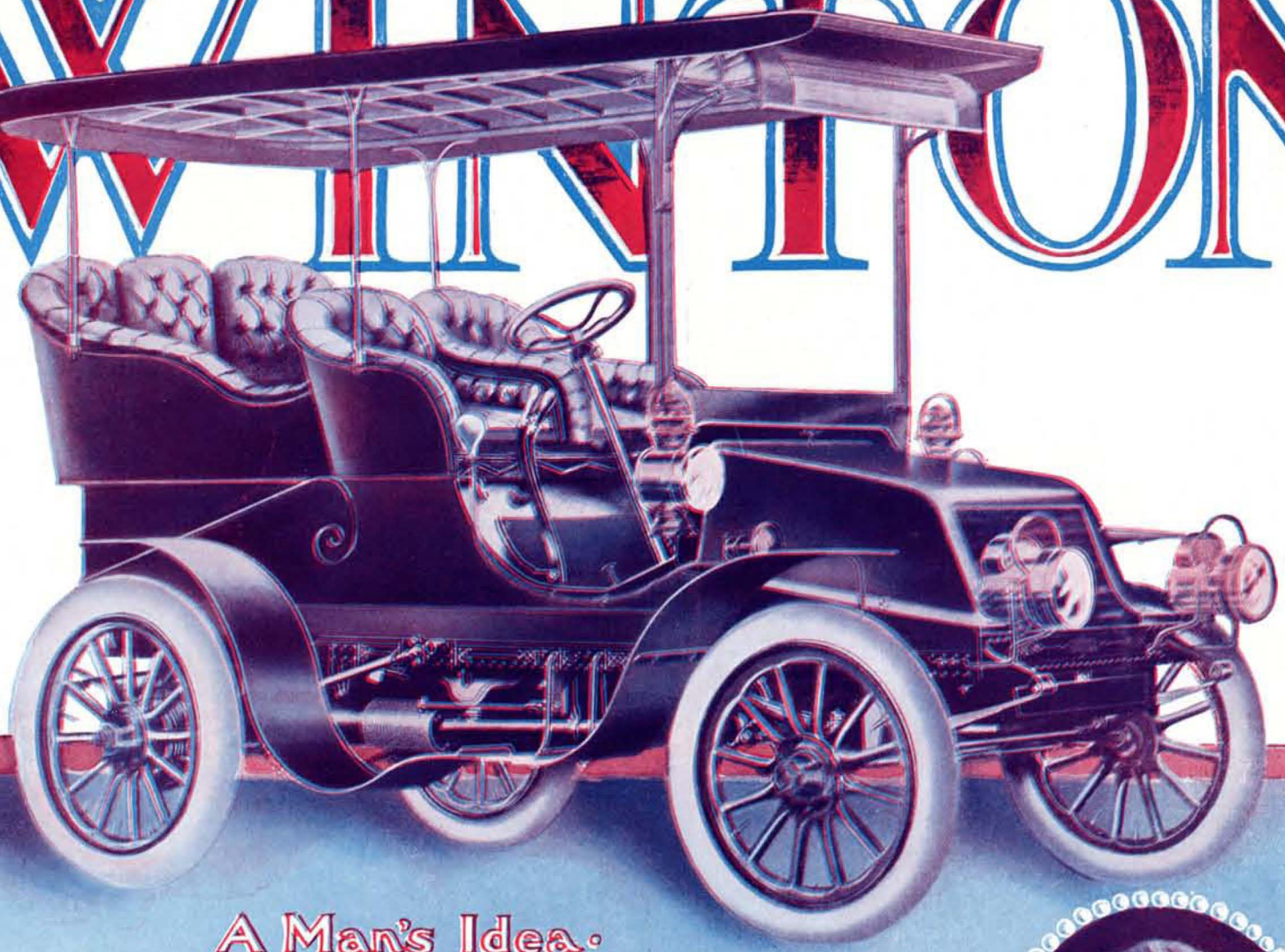

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Capitalists thought the suggestion absurd. Friends advised against a waste of precious time.

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THE WINTON MOTOR CARRIAGE CO.
CLEVELAND, OHIO. U.S.A.

MEMBER ASSOCIATION OF LICENSED AUTOMOBILE MANUFACTURERS.

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View of Exhibits From Southwest Corner of the Garden.

Exhibits as Viewed From Northeast Corner of the Garden.

THE FOURTH ANNUAL AUTOMOBILE SHOW IN MADISON SQUARE GARDEN.

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MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, JANUARY 30, 1904.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

MUSHROOM AUTOMOBILE FIRMS.

There has been a general consensus of opinion among those who are qualified to judge of good mechanical work, that the bulk of the automobiles exhibited in the New York Show this year are marked by design and workmanship of a very high order. Indeed, it is the recognition of this fact that enables the most conservative well-wisher of automobiling in America to assert with positive conviction that our leading manufacturers have moved up to the front rank, and are turning out machines that compare in design, workmanship, and beauty with the very best of foreign make. An excellent opportunity for comparison was offered by the method of classification adopted, which gathered the foreign machines in a room by themselves, and enabled one, after familiarizing himself thoroughly with foreign workmanship, to pass into the main exhibit, and make immediate comparison with the best American machines. French manufacturers had so many years' start of this country, that their superb automobiles have naturally become the mark of excellence at which our own builders have aimed; and, therefore, the fact that in the few years covered by the exhibitions held in this city, we should have been able to make up the handicap of several years that was against us, is deeply gratifying. But having said this much of the exhibit as a whole, justice to the industry, and a regard for the interests of the purchaser, demand that a word of warning should be spoken against a certain type of exhibitor whose whole plant, capital, output, and experience is represented by the one, solitary machine that he had on exhibition, but who nevertheless does not hesitate to solicit orders, in the hope that he may place enough of them on his books to guarantee the purchase of a few more tools and the employment of a few more hands at his so-called establishment. Now, we do not for a moment charge that there is any suspicion of fraud attaching to these people. What they lack, and most completely lack, is the invaluable experience and the capital which alone can enable an automobile manufacturer to turn out a really reliable machine. The history of all the first-class makers in this country has been that they passed through a period of patient investigation and exhaustive and costly experiments before they felt justified in putting a new type of construction on the market. The firms that have gone by this slow but sure road, and these firms alone, have to-day an established reputation.

But now that the period of experiment is over, and the growing confidence of the public in the automobile is resulting in a remarkable growth of the industry, we are witnessing a rush of inexperienced and often completely unqualified people into the trade (just as happened a few years ago in the bicycle industry), with the result that a lot of crude machines, which are made up largely of poor imitations of standard makes, are being offered to the public, long before they have had that exhaustive trial which alone can establish them as fit for the severe demands of every-day service on the road. Of course, these mushroom firms will, in most cases, meet with the inevitable fate of such; but not until many an inexperienced purchaser has paid dearly in providing for these firms the experience which by right they themselves should have gained before they placed a single machine on the market.

It is a most serious matter to undertake the manufacture of automobiles. We do not know of a single form of mechanism to-day that demands such supreme excellence of workmanship and materials as this; and while it is impossible to prevent speculative people from rushing thoughtlessly and without due preparation into the making and selling of machines, it is sincerely to be hoped that the automobile press, the various clubs throughout the country, and the private purchaser will discourage the mere speculator, and give their support only to those makers who can show the proper credentials.

THE RACING AUTOMOBILE AND ITS RELATION TO THE DEVELOPMENT OF THE PLEASURE VEHICLE.

To the casual spectator, the sight of a huge racing machine dashing around a track at a mile-a-minute clip is in itself an interesting and more or less thrilling spectacle. The higher the speed and the greater the risk run by the operator, the more intense is the excitement as he makes the dangerous turns amid clouds of dust. When several evenly-matched cars are running together, rounding the turns at express-train speed and in imminent danger of collision, while the chauffeurs strain every nerve in their efforts to steer them and get out of them the highest speed possible on the straight stretches, one is reminded of the mad excitement of the ancient chariot races of the Romans on the oval track of the great arena.

But apart from the excitement and exhilaration of the race, such competitive speed trials are of the greatest benefit to the automobile designer, first because, sometimes through failure and sometimes through success, they point the way to improvements in construction which, when tested and proven, are incorporated in the regular stock machines; and, secondly, because they give a chance for comparison of different forms of construction under conditions of very severe strain.

Abroad, the benefits of racing have been more generally taken advantage of, and races have largely been held on the highways, which, because of their wide, smooth surfaces, form almost perfect courses for the testing of automobiles at high speeds and over long distances. Generally a circuit fifty or seventy-five miles in circumference is laid out, and the contestants traverse it several times. The annual race for the Bennett trophy, which is an international affair, has become the classic race abroad; and, if it is ever won by an American machine, it will have the effect of introducing road racing into this country, as the race follows the cup and is always held in the country whose team won the previous year. France, England, and Germany have each had the trophy, and the race next year will be held in the last-named country. The success of the German "Mercedes" machine in 1903 has been attributed by many to the use of ball bearings in the transmission gear and other important parts, and, as a result, many of the foreign manufacturers, as well as some here, have readopted this familiar form of anti-friction bearing on their 1904 machines.

In America, racing has been largely confined to the ordinary race-track, with occasional straightaway speed trials. During the latter part of the past season, the Winton eight-cylinder racer, which failed to make any showing in the Bennett race last summer, demonstrated the soundness of its principles of construction by winning many races and making new records on various race-tracks throughout the country. Driven by Barney Oldfield, it made a mile in 55 seconds; 10 miles in 9 minutes, 32½ seconds; and 15 miles in 14 minutes, 21 seconds, all of which are track records for machines weighing over 1,800 pounds. A four-cylinder racer of the same make holds the mile, 5-mile, and 10-mile records for machines weighing from 1,200 to 1,800 pounds. The figures for these are 59 1-5 seconds; 4 minutes, 58 4-5 seconds, and 10 minutes, 6 seconds, respectively. A Decauville racer driven by Henri Page holds the 15-mile track record of 15:07 1-5 for this weight machine, while Dan Wurgis, on an Oldsmobile chassis, holds the 1 and 5-mile records for cars weighing less than 1,200 pounds, at 1:07 2-5 and 5:49.

Steam track records up to 5 miles were made last year by George C. Cannon, with his special racer equipped with a fire-tube boiler and simple steam engine. The first mile was covered in 1:01, and the five miles in 5:56 3-5. J. L. Hedges, on a White steam racer equipped with a flash generator and compound engine, made a 10-mile record of 12:20 4-5.

New track records for electric automobiles of a mile in 1:24 4-5, 5 miles in 6:29 3-5, and 10 miles in 17:58 were made last year by the Baker electric torpedo racer, in which are incorporated all the features used on the stock cars, such as ball bearings, but few cells of battery, and a low-voltage electric motor of high efficiency.

The Ormonde-Daytona beach on the east coast of Florida, pictures of which were published in our last Automobile Number, is said to be the finest speedway in the world. The second annual race meet, in which the best American, French, and German racers are entered, is being held there this week. New straightaway records were recently made there by the Packard "Gray Wolf" racer, driven by Charles Schmidt, and a Stevens-Duryea chassis, driven by Otto Nestman. The former machine has a 25-horsepower, four-cylinder motor, and weighs 1,400 pounds, while the latter has two double opposed-cylinder motors that develop 14 horse power, and weighs complete 900 pounds. Both have the same sized engines as are fitted to their respective firm's regular stock cars. The Packard 1904 "Voiture Legère" has been directly developed from the experiences of the Packard Company with its racer throughout the past season, while the Stevens-Duryea racing chassis was built to demonstrate the speed possibilities of that company's motor. This machine showed its rapid hill-climbing abilities at the Eagle Rock, N. J., hill-climbing test last Thanksgiving Day, by ascending the one-mile hill in 1:37, which was only ¼ second less than W. K. Vanderbilt, Jr.'s, time on his 60-horse power Mors racer. At the recent attempts to break records with this machine in Florida, it covered a mile in 57 1-5 seconds, thus lowering by 9 seconds the previous record for machines of this class, which was made at the same place by the Oldsmobile racer a year ago. A new 5-mile record of 4:57 3-5 was also scored. The "Gray Wolf" succeeded in coming within 2-5 of a second of tying the world's record for heavy cars (46 seconds), while its 29 2-5 seconds for the kilometer equals the record made by Baras on a light car.

Spurred on by these newly-made records on the Florida sands, Henry Ford next made an attempt to beat them on a specially prepared course on the ice. The trial was made with the reconstructed Ford-Cooper racer, and it was successful. The astonishing time of 39 2-5 seconds was recorded by the official timekeepers, which means a speed of 90 miles an hour. This new record makes it seem as though a speed of 100 miles an hour will soon be realized. Such speeds are in themselves of no benefit, yet there is no denying the fact that the strains to which they subject the mechanism of the racing cars are so far in excess of those met with by the every-day runabout or touring cars, that if these are built with practically the same strength of parts, the factor of safety must be very great. In other words, just as a piece of steel that is incorporated in a modern auto must have several times the strength necessary to withstand the stresses that are likely to be put upon it, so the complete machine should be so constructed that it as a whole has a large factor of safety. Just how strong to make every part is at first somewhat a matter of experiment, and it is far better to risk the life of one man who realizes his danger, than to jeopardize the lives of numerous purchasers who ride about unconscious of the risks they are taking. Before the development of the racing car and the trying out of parts upon it, the automobilist was liable to serious accidents, such as the breaking of the steering gear or of the rear axle; but now, as a result of these exhaustive and machine-racking speed tests, a purchaser buying a car from a firm that has had racing experience is pretty sure to obtain one that is not structurally weak, and with which there is not much chance for a dangerous breakdown.

THE FOURTH ANNUAL NEW YORK AUTOMOBILE SHOW.

The exhibits in the Fourth Annual New York Automobile Show were of such general excellence that it can, we think, be truthfully said that America has caught up with France, or, at any rate, that she is close at her heels. Many of the noteworthy features of the Paris show were found on American automobiles, such as, for example, numerous honeycomb radiators, as well as flanged tube radiators incased like those of the honeycomb type; and mechanically-operated inlet valves arranged in the cylinder head and, in some cases, placed in a single combustion chamber on one side of the cylinder. Cylinders appear generally to be cast separate and to be made interchangeable, which is also the latest foreign practice. Several of the motors were of the horizontal type, either single cylinder or double opposed. This is a strictly American type of engine, and one that is rarely met with abroad. Another motor that is gaining in popularity with the manufacturers is the air-cooled type. There were half a dozen new machines of this type that attracted general attention. On most of them copper heat-radiating flanges were shrunk on the cylinders, and the motor was placed in front where it could get the full blast of air, a fan also being employed. Cylinders four inches in diameter can, it is now claimed, be successfully cooled this way, even in the warmest weather. When this fact becomes generally known and thoroughly substantiated, we shall expect to see a revolution in the construction of gasoline automobile motors, for who would not dispense with the troublesome water circulating systems if he were sure that a simple fan could be made to do instead? A description of some of the novel methods of air cooling will be found on another page.

Many of the older manufacturers whose cars have a well-established reputation, besides making a few minor changes, have added canopy tops with glass fronts and side curtains, thus making the machines serviceable in all kinds of weather. The minor improvements consist chiefly of mechanical lubricators, giving a positive oil feed to all important bearings; the use of ball bearings in the transmission gear and rear axle; and the employment of carbureters that are automatic and that require little or no adjustment to obtain the proper mixture at all speeds of the engine.

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The three-cylinder motor is gaining some adherents, for, besides the well-known machines with one-hand control, which have used a horizontal motor of this type for the past seven years, three other firms exhibited tonneaus with vertical three-cylinder engines in front. The three-cylinder engine was a feature of the Paris show, and is said to have very steady running qualities. Large stationary engines of this type are used direct connected to dynamos for electric lighting, and they give a very steady non-fluctuating light. Such triple-cylinder motors are balanced without the use of counter-weights, since the cranks are set 120 deg. apart; and, as the impulses occur regularly every two-thirds of a revolution, the motor has an extremely steady torque.

The two-cycle motor does not seem to offer many attractions to the average manufacturer, and there was but one firm exhibiting vehicles of that type. A novel detachable glass front with side curtains was shown on one of this company's stanhopes, and a similar arrangement was found on a runabout with coupé top employing a de Dion type of motor, so that the improvements for protection against the elements are not limited to the touring cars.

Among the exhibits in the basement were to be seen a novel two-cycle motor having a crank shaft on top of the cylinders and driving the flywheel located near their base by a Reynold silent chain. In place of a crank case, each cylinder was prolonged at the bottom and carried a second piston connected to the main piston above it and, on the outside, to the crank shaft. On the downward stroke of the pistons the lower one draws the mixture into the space between them, and on the upward stroke crowds a large part of it into the working part of the cylinder through a port high up in its wall. The arrangement is intended to do away with the crank case, which in time is apt to get leaky around the crank shaft bearings. A small three-cylinder steam engine with concentric poppet valves, intended for use with a flash boiler, was also on exhibition. This engine had 3¼ x 4-inch cylinders, and was said to be capable of developing 20 horse power at 1,500 revolutions per minute.

While dealing with novel motors, mention should be made of a three-cylinder compound gasoline motor which has been thoroughly tested on the road. This motor has two four-cycle working cylinders on the outside, with a large two-cycle cylinder between them. The two outer cylinders exhaust in turn into the inner one, so that the piston of the latter gets an impulse once every revolution and exhausts into the air at a pressure of but 25 pounds per square inch.

Among the gasoline engines exhibited was a double opposed-cylinder motor made in several sizes from 6 to 60 horse power and intended to be used on vehicles with a three-speed, sliding-gear transmission of the same make. This motor has been on the market for the past two or three years and is said to be a powerful, well-built engine.

Among novelties in motor arrangement should be noted two double opposed-cylinder engines arranged side by side longitudinally of the car, and coupled together, with a common flywheel and sprocket from which a chain was run to a countershaft. Another large touring car of this make had a vertical four-cylinder motor fitted with both make-and-break and jump spark ignition. This type of double ignition is in some favor abroad.

A novel transmission device was exhibited by a well-known maker of spark plugs and coils. It consisted of a casing on the center of the rear axle, containing two rotary water motors. Connected with this casing was another on the longitudinal driving shaft. This contained four or five plunger pumps arranged in a circle and in such a way that their strokes could all be varied from nothing to the maximum. The two casings were filled with oil and were oil-tight. By starting the pump's plungers, the wheels could be made to turn very slowly, and by increasing their stroke, the wheels could be speeded up. The device has been well tested and is said to be thoroughly practical. It is a very neat solution of the transmission problem.

At the show this year the disposition of the manufacturers to satisfy the public as to the smallest details of construction and operation was apparent. Several of them showed their motors in full operation, turned by electric motors. The exhibit of a popular runabout was the finest one of this sort. The body was fitted with glass sides, and within it was a motor cylinder with the upper half cut away, showing the piston moving back and forth and the valves as they opened and closed. Even electric automobile motors were shown in the course of construction, a half-wound armature being exhibited beside a cell of Edison battery. The exhibit of Exide battery plates and separators was spread out on a large board, and was most interesting as showing the appearance of the plates of the lead pasted type of cell, the competitor of the new Edison nickel-steel battery. Several machines were shown with Edison batteries, though the majority were fitted with batteries of the lead type. The only novel electric car was a light surrey, in which the electric motor is mounted in front under the hood, and a bevel gear drive is used to the rear axle.

There were some steam vehicles on exhibition, the most prominent, of a well-known make, having a flash boiler, condenser, and a compound steam engine direct connected to the rear axle by a longitudinal shaft with bevel gear drive. Steam cars of the surrey and runabout types, which were fitted with the usual type of engine and boiler, were shown by other manufacturers, one of whom exhibited a machine fitted with a mechanical lubricator driven by the engine. A very commendable new steam vehicle was one in which the lack of reserve power characteristic of flash boilers was overcome by combining "flash" and tubular principles in one steam generator—the flash coil being located below the horizontal tubular portion, and the whole having a heating surface of 96 square feet. The engine consisted of two high-pressure cylinders opposed to two low-pressure—all horizontal, with a valve by which live steam might be turned into all cylinders—thus increasing the power, in emergencies, by simply throwing over a lever.

Wheel steering is well-nigh universal on the 1904 machines. In most instances, however, the wheel can be tilted or the steering post moved forward in order to allow the driver to enter and leave his seat with ease. The spark and throttle devices are generally placed on the wheel, and in one or two instances the change-gear lever is on the steering column also. The contact boxes of the jump spark ignition systems are generally placed so that they can be conveniently reached for inspection and adjustment. On one machine the contact box was fitted with a glass cover, while on another it was located on the front end of the car, beside the starting handle.

Dry batteries are still chiefly used as a source of current, only a few of the larger cars being fitted with magneto ignition. One interesting device that was shown separately was an electro-magnetic igniter arranged as a plug to screw into the cylinder and operated by current from a spring-actuated magneto.

Interest in automobiles, as evidenced by the attendance at the show, is much greater than in previous years. It is estimated that 30,000 people visited the Garden during the opening night and first two days of the following week. The dearth of commercial vehicles on exhibition is doubtless accounted for by the fact that the demand for pleasure vehicles is so great that manufacturers, in seeking to supply this more profitable trade, have no time to devote to the commercial automobile. Yet this is the machine that will eventually be developed, and that will relieve much of the traffic congestion in the crowded streets of all large cities. An increase in electric vehicles for business purposes was apparent.

IMPROVEMENTS AND CHANGES IN AUTOMOBILE CONSTRUCTION AS NOTED AT THE PARIS SHOW.

As the Parisian *modiste* sets the style in feminine dress, so the motor car manufacturers of that famous old-world city may be said to set the fashion in things pertaining to automobile locomotion; and it is at the annual show held in the spacious Grand Palais each December that their models for the coming year are first exhibited.

In the construction of multi-cylinder motors for the powerful gasoline cars, the cylinders are now generally cast separately instead of in pairs. This does away with the mass of metal between the cylinders, which was apt to cause unequal expansion, and makes each cylinder a unit that can be removed in case of breakage, and replaced at one's convenience. The mechanically operated inlet valve has gained not a few adherents during the past twelvemonth. Instead, however, of the inlet valve being in a chamber on one side of the cylinder and the exhaust valve being in a similar chamber on the other side, thus necessitating a cam shaft on each side of the motor for each set of valves, the practice now is to locate the two valves side by side in a single chamber, and operate them by a double cam on the single half-speed cam shaft. By this arrangement, the motor has been brought back almost to its former simplicity, while the advantages of the mechanically operated valve—quiet and steady running, with a wide range of speed—have all been retained. The use of steel cylinders has diminished considerably.

With regard to bearings, there is a decided tendency to go back to the old style ball bearings, for the engine crank shafts, as well as for the transmission gear bearings, and other important bearings throughout the car. The ease of adjustment of the ball bearing, together with its frictionless and smooth running qualities, has doubtless had much to do with influencing manufacturers toward its readoption; and if the balls are made of the best hardened steel and properly proportioned to the loads they have to carry, there seems to be no good reason why this form of bearing should not give entire satisfaction, besides having the great advantage of instant adjustment, which the ordinary plain bearing does not have.

The water circulating pump and ignition dynamo or magneto is gear driven in almost every instance, and all gears and small parts are inclosed or otherwise completely protected. A new pressed steel frame brought out by the Darracq Company has sheet steel extending inward from its side bars to a rectangular opening in which is placed the motor and transmission. The cases of these organs are bolted to the sheet steel "apron" thus formed, with the result that the chassis has a complete flooring on its front end, which protects all the parts from dust, mud, or water.

The majority of the manufacturers are using the pressed steel frames for their chassis, i. e., a frame like that just described, which is stamped out of a single piece of steel by hydraulic presses. There are, however, quite a few firms like that of Panhard & Levassor, for example, who are using the armored wood frame as heretofore, while still other makers—Renault, de Dion, etc.—stick to the tubular frame. Some cars are fitted with a honeycomb radiator without a pump, thermo-siphon circulation alone being relied on, as on the Renault cars. A novelty that will be appreciated by many is an arrangement whereby pushing in on the starting crank in order to make it engage, automatically retards the spark, and makes it impossible for the motor to kick back.

The honeycomb, or cellular radiator, although considerably in evidence, is being replaced by a modification of the old-style coiled tubes with corrugated heat-radiating disks or flanges. The new type of radiator consists of an outer rectangular frame of square cross-section (which acts also as a tank) with small horizontal or vertical flanged tubes connecting the sides or the top and bottom. Although this type of radiator is not so efficient as the honeycomb type, in which the water is held in numerous thin films, it does not spring a leak so easily, and can be repaired with greater facility. Besides the danger of leaking, the honeycomb radiator is said to give trouble from dirt or precipitated calcium carbonate choking up its passages. Furthermore, recent experiments have shown that from 46 to 60 per cent of the heat in the fuel is carried away by the cooling water when a honeycomb radiator is used; and so it is advantageous to run a motor as hot as it can be run without causing trouble, even if the water does boil away sooner and require replenishing several times a week instead of but once a month.

Improvements in carbureters form another interesting feature of the recent Paris show. Great efforts have been made to design carbureters that will accomplish the same results as the Krebs carbureter, the novelty of the previous Salon, by furnishing as nearly perfect a mixture as possible at all speeds of the motor. M. Bollée has designed a carbureter with two spraying nozzles—one in a small pipe and the other in a large one. When running at slow speeds, the air is inspired by the motor very rapidly through the smaller pipe, thus drawing a good supply of fuel from the spraying nozzle; while when the motor runs at full speed, the suction is through the larger pipe, the spraying nozzle of which delivers practically the same quantity of gasoline because the air drawn in at an increased speed passes through a larger pipe, thus making the rate of flow past the nozzle about the same. The changing from one pipe to the other is accomplished automatically according to the speed of the motor.

In ignition devices, what is known as the Eisemann magneto is coming into quite general use. This magneto, a description of which was given in SUPPLEMENT Number 1452, generates both a high-tension or jump spark current, and a low-tension current. The high-tension spark first jumps the gap between the spark plug points, thus making a passage for the low-tension primary spark, which follows instantly, and gives a hot, red spark having the best igniting properties. By the use of this specially wound magneto, a regular spark plug can be used and yet as sure and hot a spark be obtained as with the ordinary make-and-break igniter. As a number of the best machines have heretofore been fitted with both jump and contact igniters, the development of this magneto has made possible a simplification of the ignition apparatus.

The live rear axle, with bevel gear drive through a universally jointed longitudinal driving shaft, is coming more and more into vogue for all but the heaviest cars, and in a few instances it is used even on these, as on the new Hotchkiss cars, for example. The machines built by this well-known firm, the makers of the Hotchkiss rapid-fire gun, contain a great deal of fine engineering work. Among the novelties noted on them are an arrangement whereby the pitch of the blades of the fan for cooling the water can be varied, thus increasing the air draft when desired, as in climbing a long hill; a positive locking device similar to the breech-locking mechanism of a gun, whereby the main driving shaft is positively locked to the engine crank shaft after the clutch is thrown in; and steering pivots in the center of the front wheel hubs.

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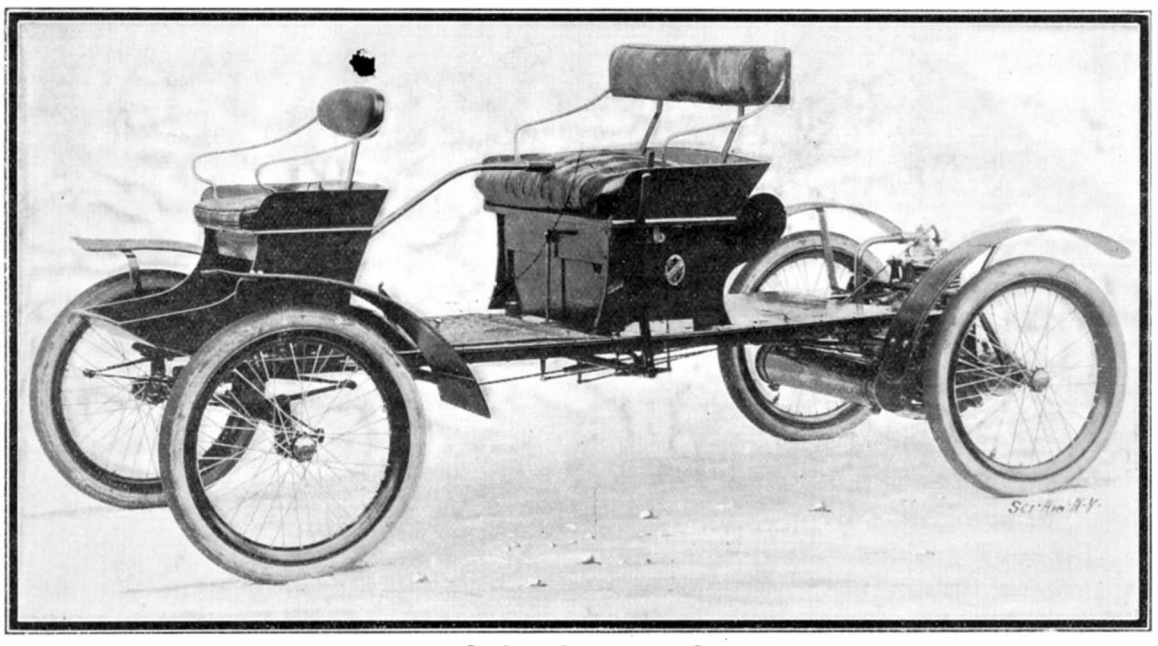
AN IMPROVED BUCKBOARD AUTOMOBILE.

The smallest, lightest, and cheapest automobile offered in the market is the Orient Buckboard, made by the Waltham Manufacturing Company, of Waltham, Mass. This is probably the simplest possible practical combination of a gasoline explosion motor and a four-wheeled road vehicle, and it has wholly superseded the motor tricycles and tandem-seated quadricycles that were so prominent during the introductory days of the automobile both in this country and in Europe. The Buckboard machine met with instantaneous success following its *début* at the Madison Square Garden automobile show a year ago, owing to its stability as compared with the bicycle and tricycle and to its closer resemblance to a "real" automobile. Moreover, in addition to being so simple that any person of ordinary intelligence and mechanical knowledge could operate it, it had a speed capacity of fully twenty miles an hour on good roads, was comfortable to ride in, and could carry two persons side by side, which overcame one of the strongest objections to the unsociable quadricycle with its tandem seats.



THE ORIENT BUCKBOARD.

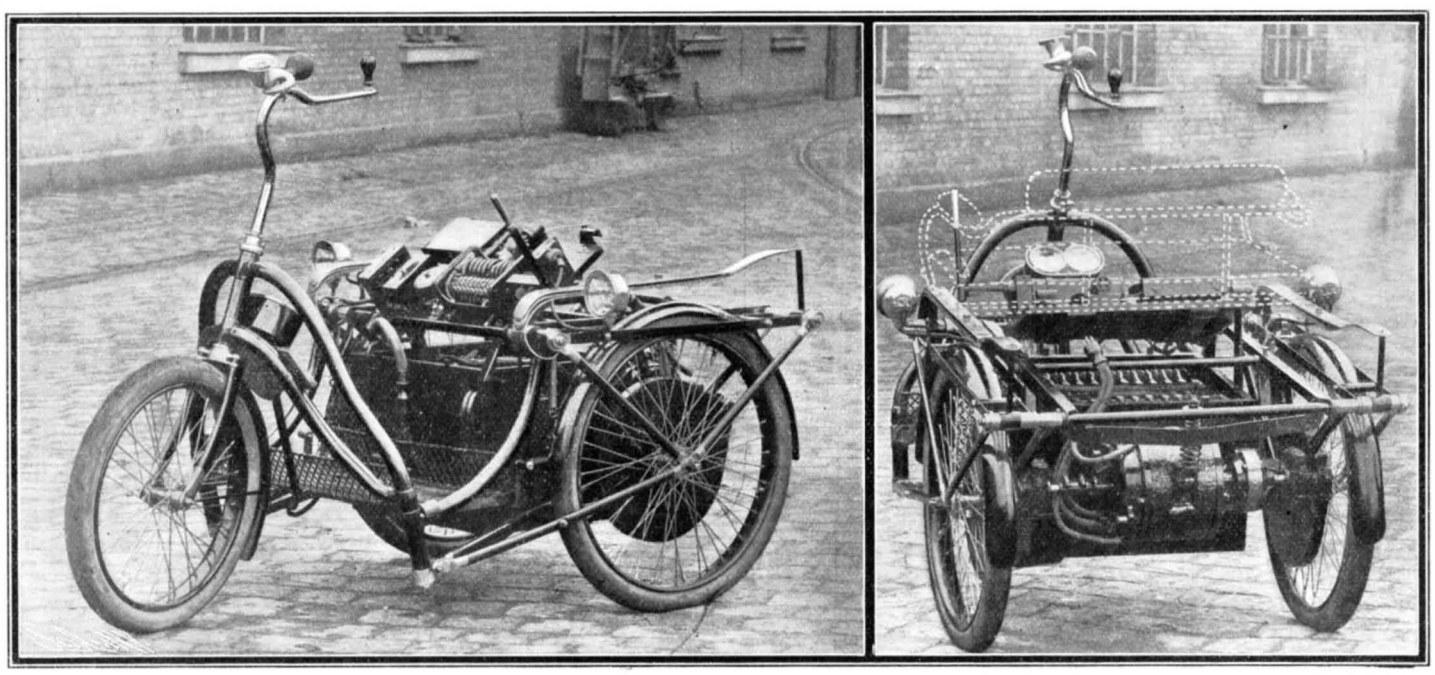
Briefly, the vehicle consists of two sets of 26-inch wire suspension wheels, the rear pair carrying at the middle of the axle a single-cylinder, air-cooled, upright gasoline motor of 4 horse power; a narrow platform, whose side members are of 1¼ by 3-inch seasoned hickory, and a cushioned buggy seat placed in the middle of this platform. The entire power and transmission mechanism is carried on the rear axle as a unit, the motor being supported in a tubular truss, the ends of which are as close as possible to the wheel bearings. The motor has flywheels inclosed in the aluminium crank-case, like a bicycle motor, and drives by a pinion a large spur gear on the differential. The gears are this year laminated with fiber to reduce the sound when running. Band brakes on the rear axle are operated by a pedal. A cylindrical gasoline tank is attached to the rear of the seat out of harm's way. The muffler is suspended below the platform just in front of the rear axle, and has been made larger this year than last to make the exhaust noiseless. Full elliptical springs have also been interposed in the new models between the rear axle and the rear end of the platform as well as under the front end of the platform, and the seat and its back have been provided with spring cushions.

Principal among the improvements for 1904, however, is the addition of a two-speed gear mechanism between the motor and the differential. This is operated by a left-hand side lever. It increases the hill-climbing ability of the machine, so that it can mount any grade met on public streets and roads, and it also enables the operator to drive slowly and carefully through streets congested with traffic and through mud and rough places. Another change is the substitution of a crank starting device for the strap and ratchet used on last year's machines. A more compact and reliable carbureter has been fitted, and mud fenders have been attached over all the wheels with bolts and nuts that are secured against working loose. Other improvements are the use of heavier hickory reaches in the platform, the raising of the platform two inches higher from the ground, and the use of a wider seat.

The Buckboard weighs about 500 pounds, is 106 inches over-all length, and 48 inches over-all width. It is finished in the natural wood. Single-tube Goodrich tires are fitted. The Waltham Company has recently brought out a carrier attachment for the buckboard to be used for delivery purposes by small merchants, such as grocers, butchers, laundrymen, druggists, dry goods, and notion stores, etc., and has also designed an extra seat for one person to be placed over the front axle as shown.

AN ELECTRIC TRICYCLE FOR POSTAL WORK.

The accompanying photographs show an electric tricycle specially constructed for the Royal Bavarian Postal Service, of Munich, by the Siemens-Schuckert Works.



THE SIEMENS-SCHUCKERT ELECTRIC AUTOMOBILE TRICYCLE.

The chassis consists of two truss frames, each of which holds a driving wheel. The hind wheels, as shown in the illustrations, are set one in each frame, and consequently there is no regular rear axle. By this arrangement, a greater space is obtained under the double seat for the storage batteries, motors, differential gear, etc.

The rear view shows very well the compact and practical arrangement of the various parts, which are so placed that there is room for a box for carrying small articles.

Both rear wheels are connected, through two strong pieces of tubing, with the double, inverted V-tubing that supports the front fork, while the cross-connection between the two side frames is made with light tubing, which conduces at the same time to simplicity of construction and ease of taking apart. The battery, the seat, and also the motor, are double spring suspended, and the differential gear renders it possible to steer the machine easily. It can be turned around in a street whose width is equal to double the length of the machine. There is both a foot and an electric brake ready at hand. The latter operates so energetically that when going at full speed and carrying two people, the machine can be brought to a full stop in from 7 to 10 feet. The machine is equipped with a motor capable of giving 1 horse power at 800 revolutions per minute. There are 24 cells of Tudor storage battery, arranged in two crates, and weighing complete 286½ pounds. They have a capacity of 18 ampere hours at a one-hour rate of discharge.

The controller has ten notches—one for the stop or off position, five forward speeds, two reverse, and two for braking. The total weight of the machine is 842 pounds, and the weight which it is capable of carrying is 352.73 pounds. Its maximum speed is 9.31 miles an hour.

THE 24 HORSEPOWER POPE-TOLEDO TOURING CAR.

The 1904 Pope-Toledo gasoline touring car differs radically from all previous models, and embodies many of the latest ideas in automobile construction.

The motor has four vertical cylinders of 4¼-inch bore and 5¼-inch stroke, and develops 24 horse power at a speed of 900 revolutions. The cylinders are cast separately without water jackets, and are merely flanged tubes, bored with great care within and machined on the outside to an even thickness. The water jackets, which are of copper, are corrugated to allow for expansion. The lower ends of the jackets are slipped into grooves turned in the cylinder flanges and "sweated" in place, after which the grooves are filled with solder. The upper ends of the copper jackets are turned in, and form gaskets between the cylinders and the cast-iron combustion chambers. This arrangement of cylinders and water jackets obviates the necessity for difficult cored work in casting the cylinders, while the fact that the cylinder walls are of even thickness assures equal expansion when they become heated. Further than this, the construction described affords ample opportunity to reduce weight to a minimum, although no strength is sacrificed.

The Toledo Company still maintains its claim that automatic inlet valves are preferable to the mechanically-operated variety, and its latest motors are so fitted. The inlet valves are held in place by strut pieces, which engage the heads of suitably-placed screws, and may be removed quickly and without difficulty. The inlet valves are forged of nickel steel, and the exhaust valves are of a special nickel alloy, which is practically the pure metal. It is generally conceded that nickel is particularly suitable for exhaust valves, as it does not warp under the ordinary heat developed by the engine, while constant "pitting" is eliminated by its use.

The cam shaft runs within a chamber cast integral with the upper half of the aluminium crank case, and the cams and shaft journals are splash-lubricated. The two-to-one gears are unusually large. The circulating pump, which is of the gear type, is mounted on the exhaust-valve side of the motor at the extreme front end of the crank case, and is driven from the large cam-shaft gear. The pump-driving gear carries a boss on which the fan pulley is mounted, the fan being belt-driven. The engine bearings are of bronze. They are cast in halves, accurately surfaced on a milling machine, soldered together and machined up as a single casting, and then separated, the bearing surfaces being scraped by hand to remove all tool marks and assure a perfect fit.

An efficient circulating system makes the use of a large supply of cooling water unnecessary, only 3½ gallons approximately being required. The construction of the radiator is such that the water is obliged to circulate back and forth from the top to the bottom in a very thin film; thus every drop is subject to the cooling influence, whether the system is filled or not, a feature not common to all types of radiators. The water is forced from the bottom of the radiator

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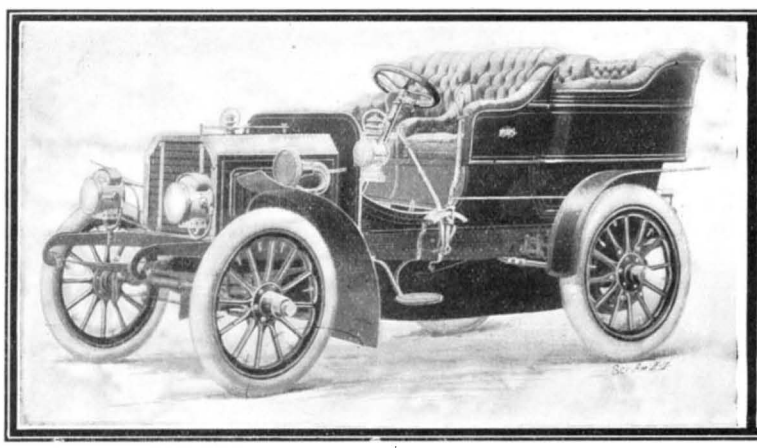
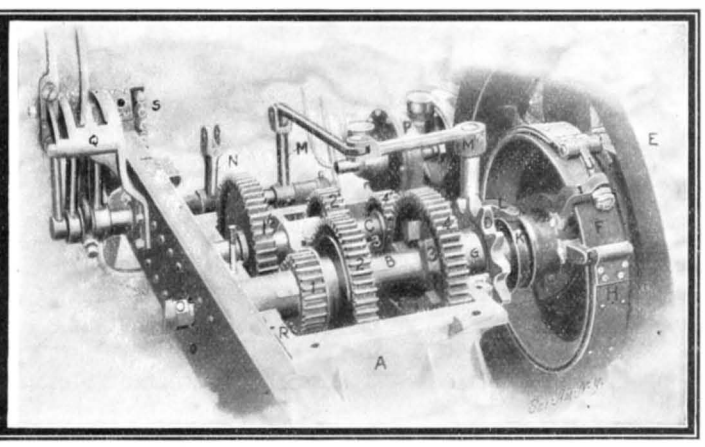
to the lower ends of the cylinder jackets, passing around the cylinders and back to the radiator, which it enters at the top. No separate water tank is carried. A small overflow tube conveys excess water to the ground when filling the circulating system. Compression relief cocks, which are tapped into the cylinders, are connected by a linked rod which extends through the radiator and terminates in a small brass knob, a single movement of which relieves the compression in the four cylinders.

The 1904 Toledo transmission is clearly shown in the accompanying line engraving. It is designed for three forward speeds and a reverse, and the drive is direct on the high gear, the secondary shaft and gears being idle, a result not always attained in "direct drive" transmission mechanisms.



THE STEARNS 24 HORSEPOWER TOURING CAR.



TRANSMISSION OF STEARNS CAR.

Referring to the drawing, the mechanical details and method of operation may be easily understood. Shaft *A* is driven by the motor, and communicates the power to the sliding gear sleeve, *U*, through the medium of the two bevel gears, *C*. Sleeve *U* carries sliding gears, *D* and *D'*, and the male portion, *O*, of a miter gear clutch. These parts are free to move endwise, but are prevented from turning independently of the sleeve by long feathers set in opposite sides of the sleeve. The sleeve, *U*, is free to turn on the transverse transmission shaft, *B*. Directly below this shaft is a countershaft, which carries gears *F*, *F'*, and *P*. The operation of this mechanism is as follows:

It will be noted that driving gear, *E*, is not fixed to the differential case, but may be held in driving relation thereto by the spring, *Q*, which normally presses the spur driving gear, *E*, against hub, *H*, and causes miter teeth on the right-hand face of its hub to mesh with similar teeth on *H*, which is integral with the differential gear case and has miter teeth on its other side also. When teeth on *E* mesh with those on *H*, *E* is locked to the differential case. This relation exists only when the car is being driven on the slow or intermediate speed or the reverse. It will be seen that when driving on the slow speed, sliding gear, *D*, meshes with gear, *F*, on the countershaft, and power is transmitted through the shaft and pinion, *P*, which is in mesh with gear, *E*. The ratio of this gear system is 8 to 1. On the intermediate speed, sliding gear, *D'*, meshes with pinion, *F'*, on the countershaft, and the power is conveyed to the driving shaft through pinion, *P*, and gear, *E*, as before. The ratio of this combination is 5 to 1. In reversing, sliding gear, *D*, is meshed with pinion, *G*, and power is transmitted through the reverse shaft and pinion, *G'*, and gear, *F*.

The most interesting feature of the new Toledo transmission is the method of driving on the high speed, at which time the only gears in mesh between the motor and the driving wheels are the bevel gears, *C*. This is accomplished by sliding the gear set, *DD'*, to the left until its miter teeth, *O*, are in mesh with those on hub, *H*. This movement also pushes gear, *E*, to the left sufficiently to disengage miter gears on its hub from those on *H*, thus releasing the countershaft and establishing a positive connection between sleeve, *U*, and the differential. On returning to the lower speeds, spring, *Q*, again establishes a positive driving relation between gears *E* and hub *H*.

Further reference to the drawing of the transmission will show that ball bearings are used extensively, the bearings being unusually long, while every opportunity for close adjustment is afforded by the construction.

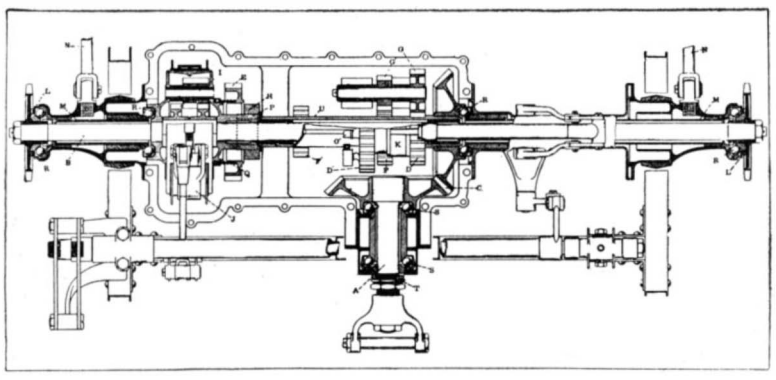


DIAGRAM OF TRANSMISSION OF THE POPE-TOLEDO CAR.

An internal cone clutch with multiple springs takes the place of the ordinary push clutch found in previously designed Toledo cars. The mechanism is entirely inclosed, while at the same time the interior is readily accessible by removing the friction ring, which is bolted to the rim of the flywheel. The end thrust of the clutch spring is relieved from the motor shaft by means of a large ball bearing thrust collar, and the springs are easily adjustable from outside the clutch by means of screw plugs with lock nuts. When the clutch is engaged there is virtually no end thrust.

The three forward speeds and the reverse are controlled by a single lever. The brake lever applies two hub brakes and releases the clutch. The hub brakes are of the expanding-ring type, while a pedal-actuated band brake operates on a drum carried by the differential.

The wheel base of the car is 93 inches, and the tread is standard. The front wheels are 32 inches in diameter, and the rear wheels are 34 inches. The tires are 4 inches in diameter.

The frame of the car is of pressed steel, and the side bars are extended to form "pump-handle" spring hangers. Sheet steel is used extensively in the construction of the car, notably in the curved seat panels and the hollow dash. These parts are pressed into shape in special dies and, being perfectly smooth, present a suitable surface for the finishing enamel, which is baked on, and is a durable and attractive substitute for paint.

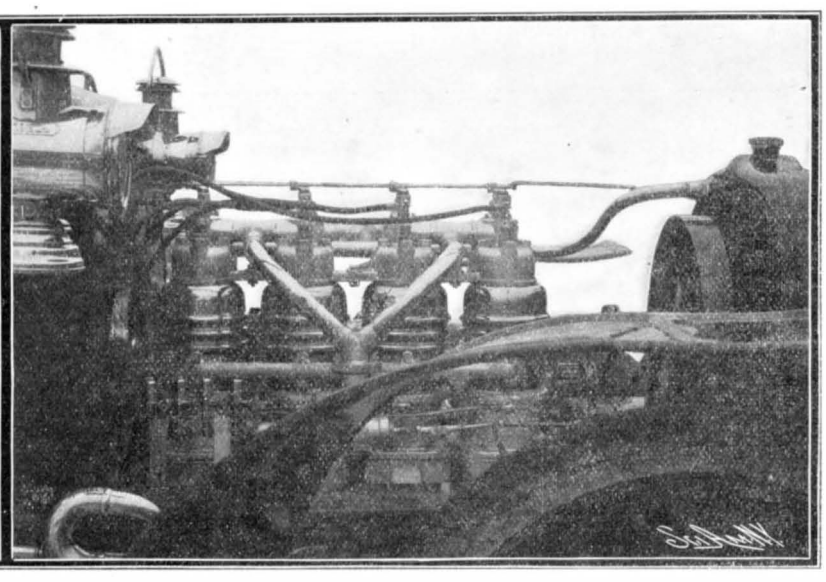
The Pope-Toledo car is built by the Pope Motor Car Company, of Toledo, Ohio.

THE STEARNS GASOLINE TOURING CAR.

The Stearns car and its transmission are shown in the accompanying cuts. This machine is a powerful touring car with a motor of the double, opposed-cylinder type, running at a normal speed of 900 revolutions per minute, and capable of driving the car as fast as 50 miles an hour. The motor is fitted with a brass water jacket square in cross-section. It is fed with gas from two float-feed, atomizing carbureters in which the suction is against the spraying nozzle instead of in the direction in which it points. This novel construction is said to offer advantages in the way of supplying a good mixture at widely varying speeds. The cooling water is circulated by a centrifugal pump, *P*, friction-driven from the flywheel, through a flanged radiator consisting of about a dozen small copper pipes laid side by side horizontally in front of the bonnet and coiled back and forth in an S-shaped formation. The warm water of the cooling system enters the bottom of the oil tank and heats the oil, at the same time putting a pressure on it and causing it to flow to the six sight feeds that supply oil to the motor through small copper pipes. The pipes that oil the cranks are curved so that the drops of oil forming in the ends of them are caught in small cups on the crank-pin boxes, as the cranks pass under the oil-pipe ends.

The transmission gears run in an oil-tight case, *A*. The flywheel is shown at *E*, and the band brake clutch, *J H*, by clamping the drum, *F*, of the flywheel when the shipper, *K*, spreads levers, *I I*, drives the shaft, *B*, through levers, *I I*, which are mounted on studs on a flange at end of *B*. The gears are slid in mesh by a lever working in the H-shaped slot, *Q*. They are of the usual pattern, giving a direct drive on the high speed by the meshing of miter gears, 3, 3. The first and second speeds are obtained through 1, 1', 4', 4, and 2, 2', 4' 4 respectively, gear 4, sleeve *G*, and sprocket *D* being one solid piece of steel. In the position shown, the reverse is accomplished by raising a wide intermediate pinion beneath 1 and 1' so that it meshes with each gear. The motor is started by a crank applied at *O*. The frame of the Stearns machine is of armored wood. The car has a long wheel base and large 34 and 36-inch artillery wheels shod with 4 and 4½-inch tires. The throttle control of the motor is very flexible, thus making it possible to obtain speeds of from 5 to 50 miles an hour on the high gear. The throttles on both carbureters are operated by a pedal, or they can be set by a handle on the steering wheel. One of these machines made an extremely good showing in the New York-Pittsburg run last October, and, despite some mishaps due to hard driving, reached Pittsburg among the first at the end of the contest.

THE POPE-TOLEDO 24-HORSEPOWER TOURING CAR.



SEPARATE CYLINDERS OF MOTOR, SHOWING CORRUGATED COPPER JACKETS.

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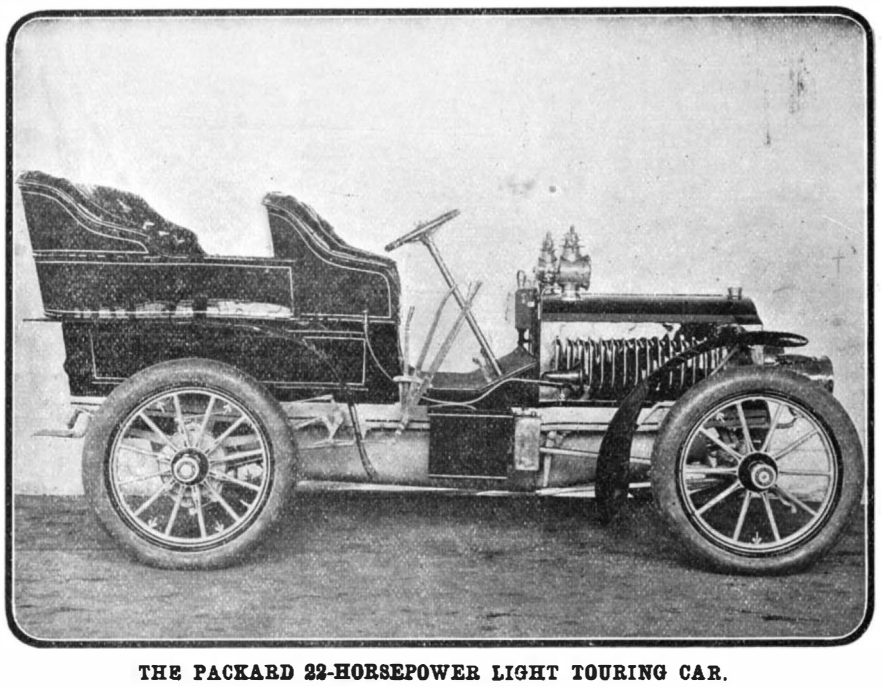
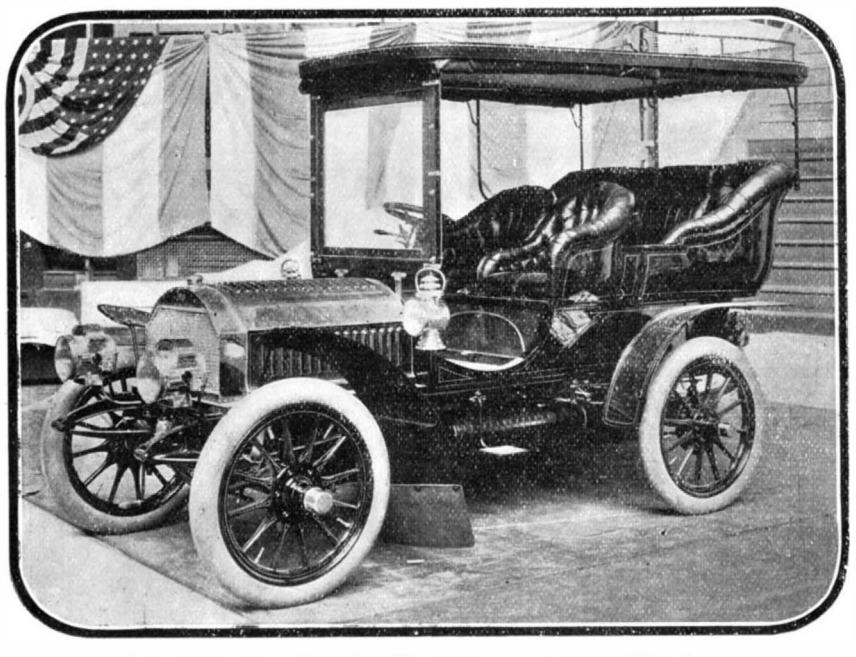
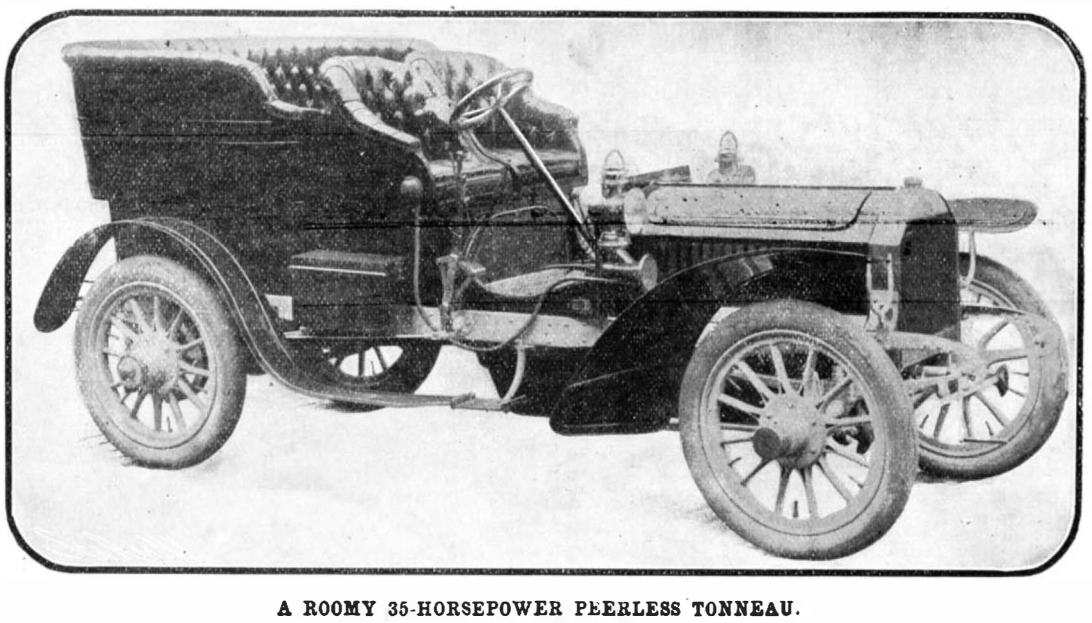


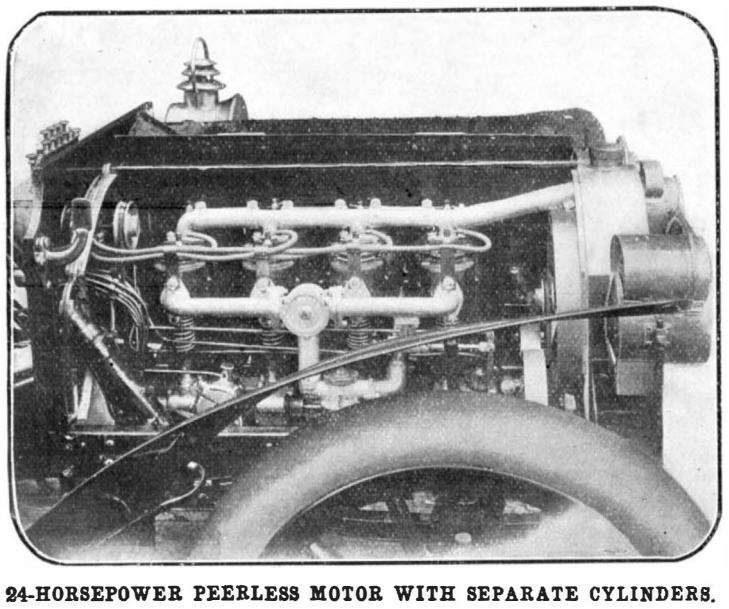
THE PACKARD 22-HORSEPOWER LIGHT TOURING CAR.



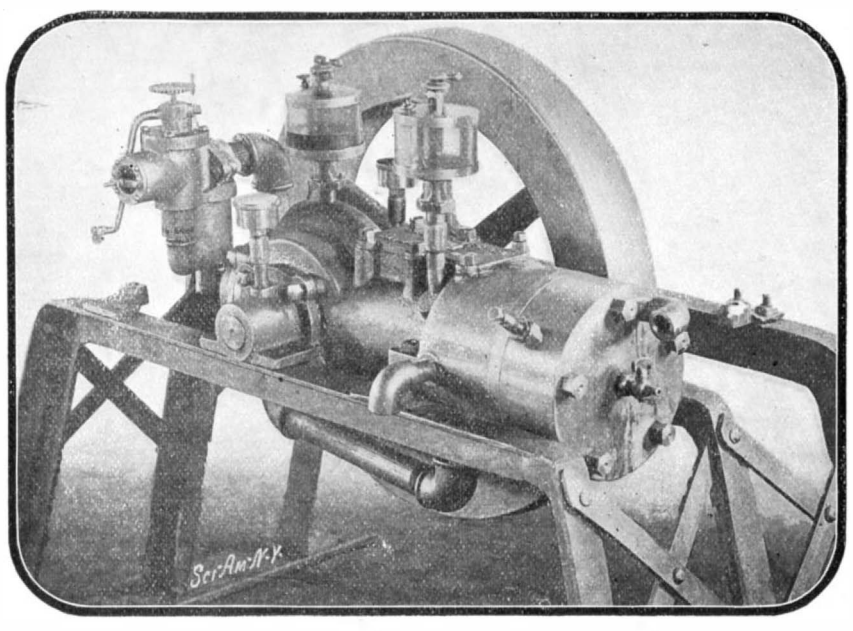
PIERCE 24-HORSEPOWER TOURING CAR WITH CANOPY TOP.



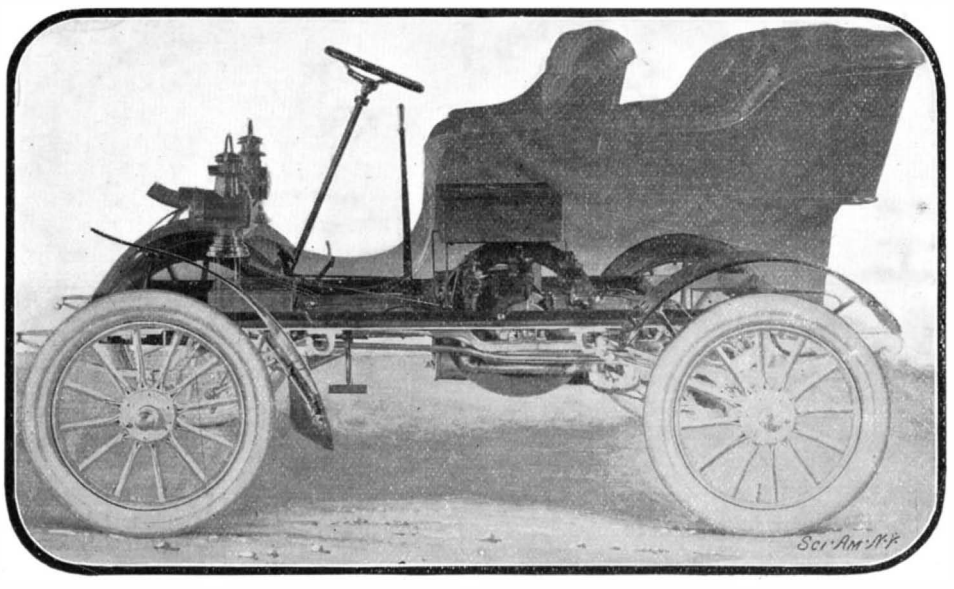
A ROOMY 35-HORSEPOWER PEERLESS TONNEAU.



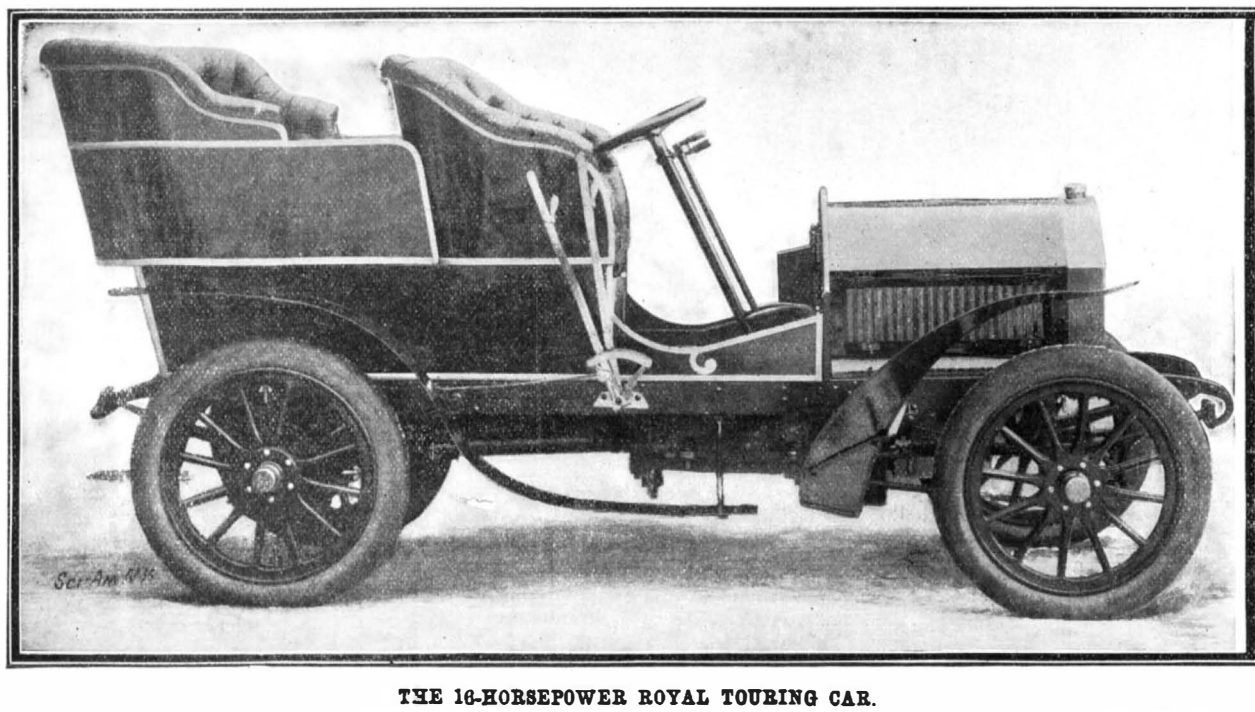
24-HORSEPOWER PEERLESS MOTOR WITH SEPARATE CYLINDERS.



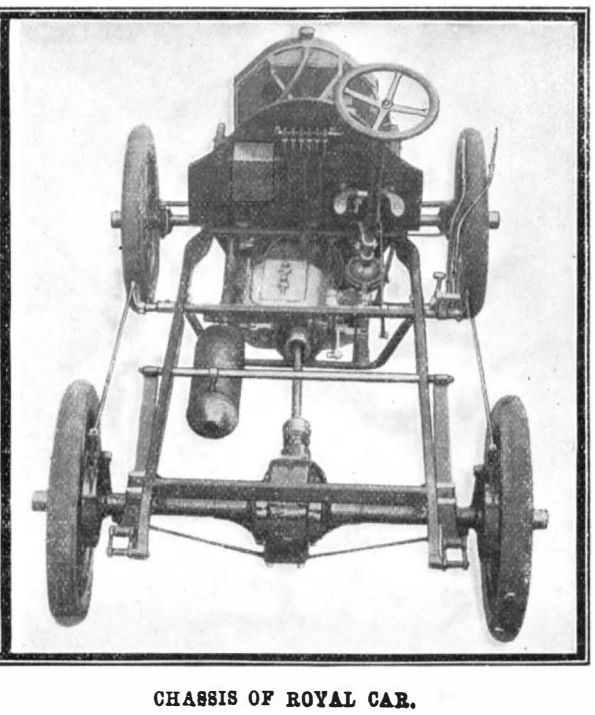
7-HORSEPOWER TWO-CYCLE MOTOR OF THE ELMORE TONNEAU.



ELMORE TONNEAU, SHOWING LOCATION OF MOTOR.



THE 16-HORSEPOWER ROYAL TOURING CAR.



CHASSIS OF ROYAL CAR.

SOME 1904 MODELS OF TOURING CARS AT THE NEW YORK AUTOMOBILE SHOW

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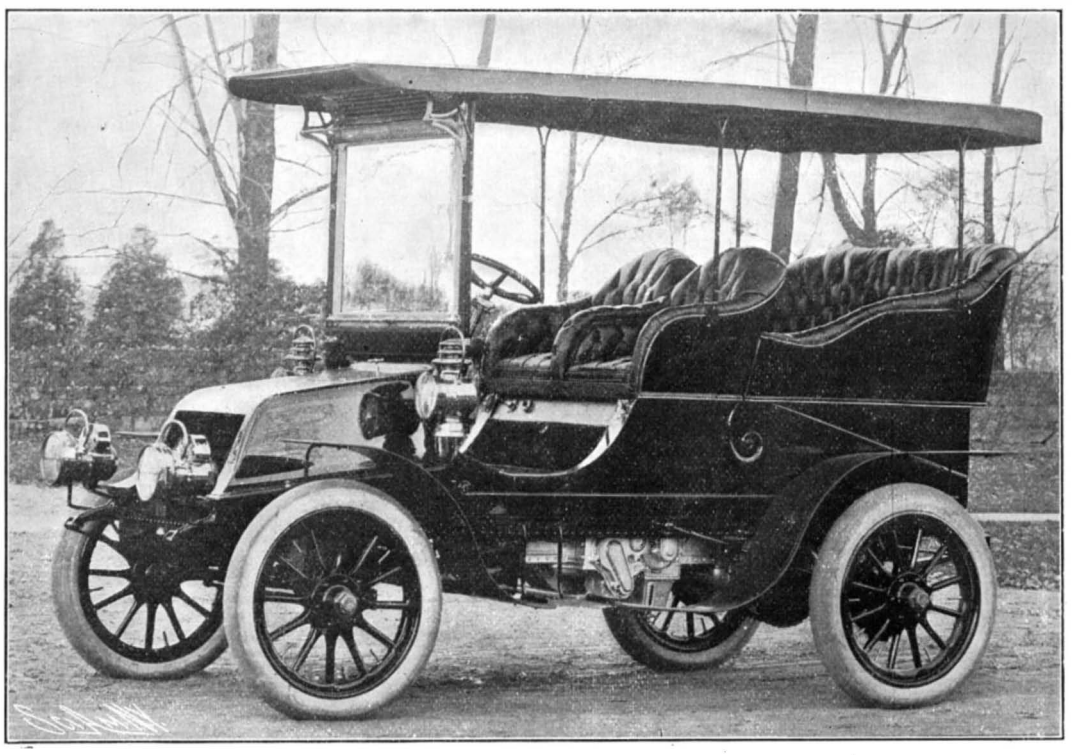
SOME 1904 TOURING CARS.

The new Packard "Voiture Legère," or light car, has been developed from the Packard racer, the "Gray Wolf," which covered a mile in 46 2-5 seconds recently on a Florida beach. The car weighs but 85 pounds per horse power developed by the motor. Its total weight is less than 1,900 pounds, and its four-cylinder motor is rated at 22 horse power. The machine is fitted with a combined three-speed transmission gear and differential on the rear axle, which causes its power plant to consist of but two units—the motor and the driving axle. Upon the high speed the drive is direct from engine to axle. So flexible is the engine control that the machine can be throttled down so as to reduce the speed of the car from 40 to 4 miles an hour, and when running at this latter speed on the high gear it may be kept describing a 30-foot circle as long as desired. The motor has four cylinders of 3⅞-inch bore and 5½-inch stroke. Both its inlet and exhaust valves are mechanically operated and interchangeable. The oil level in the crank case for splash lubrication is maintained by a gear-driven pump. Jump-spark ignition, with separate coils and a storage battery, is employed. A rotary gear pump, gear driven, circulates the cooling water, which is contained in a fan-cooled, cellular radiator and the piping. But one pint of water is evaporated in 80 miles, and 300 miles can be covered on a quart of oil, while on fairly good roads the gasoline consumption is as low as one gallon per 18 miles.

Ball bearings are used on the axle, wheels, and transmission. The flywheel clutch is of the expanding ring type. A worm-and-sector steering device is used. The brakes are of the expanding ring type (worked by a pedal) and band or clamping ring type (worked by a self-locking hand lever). They operate on drums on the hubs of the rear wheels. Both sets are double acting and capable of locking the rear wheels. The motor is controlled by a centrifugal governor, the action of which can be counteracted by a hand lever on a sector on the steering wheel. The spark-controlling handle is also placed here.

The wheel base of the car is 94 inches, and the tread standard. The wheels are shod with 4 x 34-inch detachable tires. The Packard three-point spring suspension is used.

The George N. Pierce Company has brought out for 1904 a new and commodious "King of the Belgians" touring car fitted with a 24-horsepower, four-cylinder motor having mechanically-operated inlet valves on one side of the cylinder head and exhaust valves on the other. The cylinders are separate and interchangeable. The motor is so constructed that the lower half of the crank case can be removed without disturbing the crank shaft or its bearings. The valve caps, also, are readily removable. A plunger pump, worked by an eccentric on the exhaust valve cam shaft, forces oil from the crank case to a reservoir on top of the cylinders. A pipe from this reservoir leads to the three crank shaft bearings and directs a continuous flow of oil upon them. The oil enters the hollow crank shaft through holes and flows along to the crank pins, where it passes out, lubricates the crank pin boxes, and is thrown up into the cylinders. The water-circulating pump is on an extension of the exhaust valve cam shaft. A cellular radiator is used. The bore and stroke of the motor cylinders are 3½ and 4¼ inches respectively, and its normal speed is 1,000 revolutions per minute. It is said to have developed 28.3 brake horse power under test. The car is fitted with a three-speed, sliding-gear transmission. Any speed from 6 to 45 miles an hour can be had on the high gear by means of the throttle, though the motor is controlled automatically by means of a governor. This is inclosed and fitted on the front end of the inlet valve cam shaft, which is prolonged so as to project beyond the front of the car and carry the contact box, thus making the latter very accessible. The motor and transmission are on a separate underframe, so that they cannot easily get out of alignment. The speed-change lever is on the steering column. The clutch must be disconnected before the gears can be shifted, and it cannot be thrown in till they are completely in mesh. The clutches and change gear levers are mounted on ball bearings, as are also the front and rear axles and the transmission gear. The car is fitted with a countershaft brake and with brakes on the rear wheel hubs. The weight of the machine is 2,400 pounds, its wheel base is 93 inches, and the tread is standard. The tires are 34 x 4 inches, detachable.



THE 1904 WINTON 20-HORSEPOWER TOURING CAR.

The 35-horsepower Peerless car is a striking-looking vehicle, the wheel base being unusually long—102 inches—while a low, rakish-looking bonnet, which covers and protects the motor and its accessory parts, occupies a full third of the length of the car. The 34-inch wood wheels are mounted on large ball bearings, and the tires are of the double-tube type, 4½ inches in diameter. The frame of this vehicle is of channel section pressed steel, the side girders tapering toward the ends and approaching each other in front, which allows extra clearance for steering.

The 35-horsepower motor is of the four-cylinder, vertical type, the cylinders being 4⅝ by 5½ inches each. They are cast in pairs, with integral combustion chambers and water jackets, and are securely bolted to a two-piece aluminium crank case, the lower half of which carries the motor supports. The inlet valves are mechanically operated in the usual way, but as they are on the opposite side of the motor to the exhaust valves, an extra half-time, or secondary, cam shaft is used. This shaft also drives a forced-feed lubricator and the ignition commutator. The exhaust-valve cam shaft carries an intermediate gear, which operates the circulating pump. This is mounted on the motor case at a point between the two pairs of cylinders, the whole being arranged in a very compact manner.

The cam shafts are mounted in removable bearings protected by light aluminium covers.

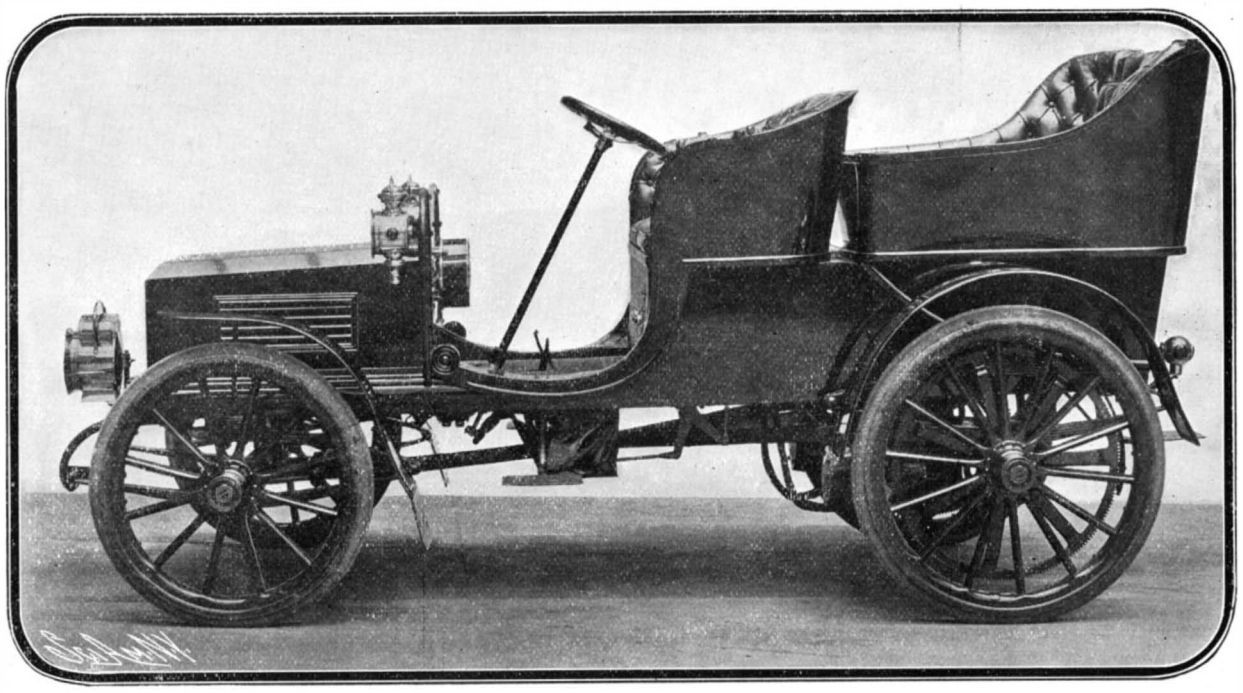
A double ignition system is employed on the 35-horsepower motor, a make-and-break low-tension system being fitted and used as accessory to the usual jump-spark system. The change from one to the other can be made from the seat of the car while it is in motion. The current is supplied by a storage battery.

The cylinders are lubricated by a belt-driven, adjustable, sight-feed lubricator, which is mounted on the dash of the vehicle, and which also supplies the crank-shaft bearings. Splash lubrication is depended on for oiling the wrist pins and cam shaft bearings. The speed of the motor is controlled by a throttle governor, the action of which is retarded at will by applying the foot to a small accelerator pedal. A cellular radiator is employed, and its effect is augmented by a motor-driven fan.

The transmission is of the sliding-gear type, that of the 35-horsepower car being designed for four forward speeds and a reverse. The various speed changes are made by a single lever moving in an H-shaped slot. The secondary shaft runs idle while the car is being driven on the high gear.

Oil for the transmission is fed to the primary and secondary shafts, from reservoirs below, by means of chain conveyors, and the gears run continuously in an oil bath. A flywheel cone clutch, leather-faced, which is self-contained and of standard Peerless design, is employed. The bearing surfaces are large, to prevent slipping when the car is in operation.

The car is driven by bevel gears, a universally jointed driving shaft transmitting the power from the secondary gear shaft to the rear axle, which carries the differential. The wearing surfaces of the universal joints are large, in order to withstand the wear to which they are necessarily subjected. The action of the vehicle springs is compensated for by means of a sliding sleeve or telescopic union. The transverse driving shaft, or rear axle proper, is carried in a tubular axle, and extends through the hubs of the rear wheels, which are driven through the medium of clutch plates, these connections allowing the required degree of flexibility. The wheels are mounted on the tubular axle and revolve on ball bearings. The object of this rear axle design is to relieve the driving axle of the weight of the vehicle and its passengers, a minor advantage being that the tubular axle can be arched if desired to form a truss. The inner ends of the driving axle are provided with universal joints to compensate for their angularity. The differential and bevel gears are protected by an aluminium case, the cover of which may be quickly removed. All bearings are packed with grease in sufficient quantity to lubricate the parts for several months.



THE WOODS ELECTRIC TONNEAU.

Three powerful brakes are provided, two of which operate on drums mounted on the rear wheels, and are actuated by a hand lever. The third brake, which is operated by a pedal, is applied on a drum mounted on the transmission shaft. The steering mechanism is interlocking. Ball bearings are used generously in the construction of the Peerless car.

There are so many features in common between the motor and other mechanism just described and that of the 24-horsepower Peerless car, that it will suffice to give a brief outline of the differences between them to convey an accurate impression of the design and construction of the smaller vehicle. On referring to the illustration of the 24-horsepower motor, it will be seen that the four cylinders are separate, instead

(*Continued on page* 110.)

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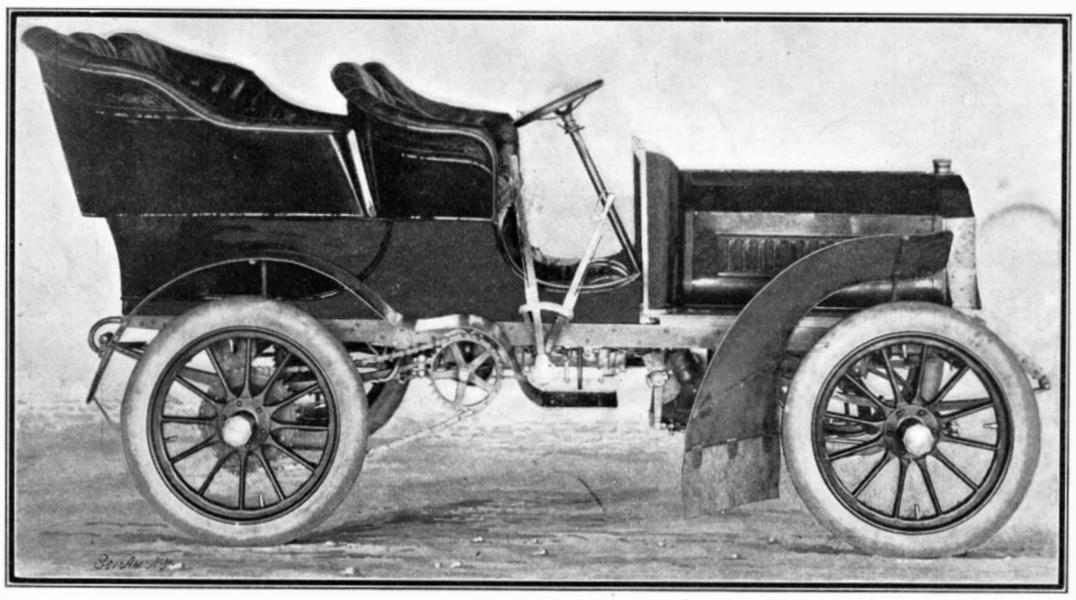
THE THOMAS TRIPLE-CYLINDER TOURING CAR.

One of the most progressive automobile firms in this country is the E. R. Thomas Motor Company, of Buffalo. Starting with the manufacture of motor bicycles, in which it soon made a good name for itself, this company entered the automobile field two years ago with a horizontal, single-cylinder car, which, as built the past year, had several novel improvements. After considerable experimenting with two-cylinder motors, the company built a three-cylinder, which, being well designed and constructed of the best material procurable, should give excellent satisfaction in service.

The advantages of the triple-cylinder motor have been long upheld in this country by Mr. Charles E. Duryea, who has used this type of engine successfully for the past seven years; while in France, Panhard & Levassor brought out last year a triple-cylinder car, and the declaration in favor of the three-cylinder engine by this well-known firm has had much to do in drawing the attention of automobilists to its advantages. These are—reduction of one-fourth the working parts necessary with a four-cylinder motor; nearly as constant torque as with four cylinders, an impulse being had every two-thirds revolution instead of every one-half revolution; and almost perfect balance, making the use of counterweights unnecessary, and yet providing without them an exceedingly smooth-running, vibrationless motor. Furthermore, a triple-cylinder motor furnishes more power for a given weight than any other, and it is largely owing to its use that the Thomas car is constructed with a weight of but 83 pounds per horse power.



THE THOMAS 24 HORSEPOWER TRIPLE-CYLINDER TOURING CAR.

The new Thomas machine has several improvements in the mechanism of the car itself, besides the triple-cylinder motor that drives it. Among these should be mentioned a novel flywheel clutch, with which there is never any end thrust while the clutch is engaged; a new adjustable worm-gear steering device, having the worm curved to conform with the sector, so that it bears against it throughout its whole length; an arrangement for shifting the secondary shaft of the transmission gear, so that it will not revolve when the high speed is thrown in; individual brakes on each half of the differential countershaft, and a safety ratchet device in the hubs of the rear wheels, by which they can be locked, and thus prevent the machine from running down hill backward should the brakes give out or fail to work.

By referring to the cut of the chassis, the reader can see the general arrangement of parts, as well as a few details of the same. The clutch ring, *R*, is seen bolted to the flywheel, with the cone clutch, *C*, within and pressed out against *R* by means of a coiled spring which surrounds and bears against the flywheel hub. *C* is mounted on a short shaft, the forward end of which telescopes into the end of the crank shaft, while the other end connects with the main transmission drive shaft (*C*, Fig. 1) through a universal joint. A ball thrust bearing on the forward side of *C* takes up the thrust of the clutch spring when the clutch is thrown out. When the clutch is in, there is no thrust to be taken care of, as the spring presses against the flywheel on one end and against the clutch cone, which is against the clutch ring, on the other. The leather of the cone clutch is attached in properly-spaced squares, and there are several spring-pressed plungers that engage first when the clutch is thrown in, thus causing it to take hold easily and without a jerk. The clutch is operated by the shipper and pedal, as can be readily seen.

The three small cuts show the details of the countershaft end with its wide, dust-proof, Hyatt roller bearing, sprocket, brake drum, and universal joint; a rear wheel, with the sprocket mounted on a cast-steel drum between the two sets of adjustable Timkin rollers; and the worm-gear steering device, completely incased, and with the worm conforming to the shape of the sector. The construction of this device, and the method of taking up wear, may be described as follows:

The steering shaft, to which the worm is secured, is tapered one-half the length of the worm, which has a corresponding taper, and is further provided with a key, so that, when worn, if it is pressed on the shaft, and locked with jam nuts, it is impossible to work loose. When the worm shaft has been adjusted to position, it is then locked with the set screw and jam nuts on the bottom.

The sector is made of hard bronze, and is securely attached to the spokes of its hub with bolts, nuts, and cotter pins. The hub is of steel, keyed and brazed to the cross shaft. To this shaft the lever arm is attached outside the casing by means of a taper Woodruff key and nut, the last of which is secured with a cotter pin.

The construction of the sector in two parts permits of adjustment to compensate for any wear, by simply loosening the bolts, moving the sector toward the worm until all lost motion is taken up (provision for which is made by the holes in the spokes of the hub being slightly elongated), and then tightening securely. This type of worm and gear will not, it is claimed, require adjustment for an entire season.

The transmission gear of the new Thomas car has all the latest improvements. As usual with this type of gear, there is a square main shaft, *A*, on which slide the two gears, 4 and 6. This shaft is round at its forward end where it telescopes into the shaft, *C*, which acts as a bearing for it. It is supported near its other end in a suitable bearing, and it has a driving bevel gear, 8, keyed on and bolted to a flange near this end. Gears 4 and 6 are slid by means of a shifting fork which is moved by the rod, *R*. In the position shown, which gives the low speed, the drive is from 1 to 2 and from 3 to 4. By sliding 4 and 6 to the right, the middle speed, 1, 2, 5, 6. is obtained. Sliding 4 and 6 still further to the right causes the tapered miter gears, *a*, *b*, to mesh and drive the shaft *A* direct, which gives the high speed. As the rod, *R*, moves

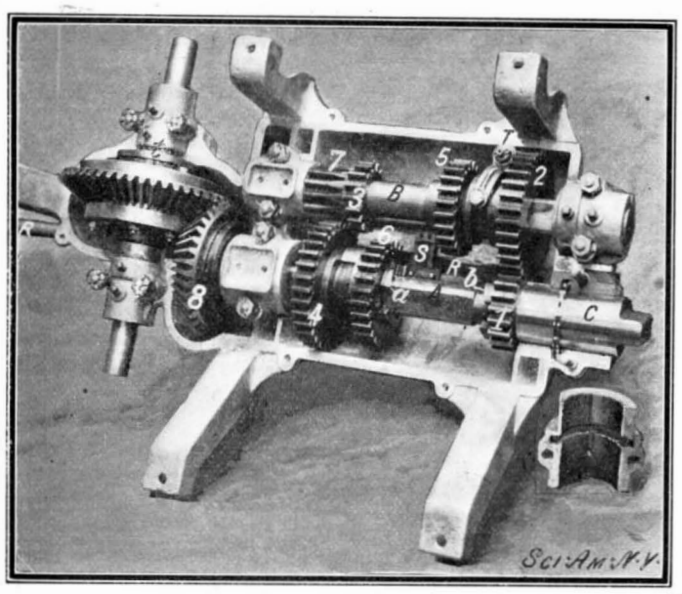


Fig. 1.—THOMAS SLIDING-GEAR TRANSMISSION.

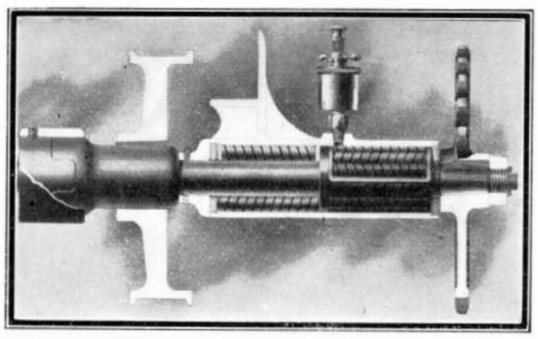


Fig. 3.—HYATT ROLLER BEARING ON COUNTERSHAFT.

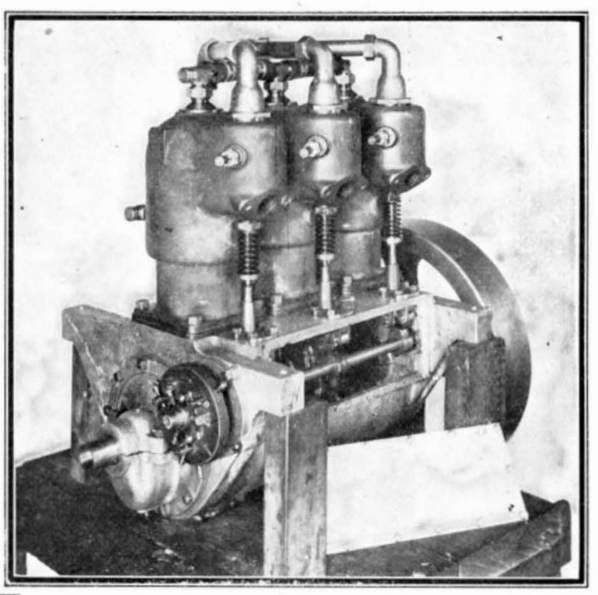


Fig. 2.—THOMAS TRIPLE-CYLINDER MOTOR.

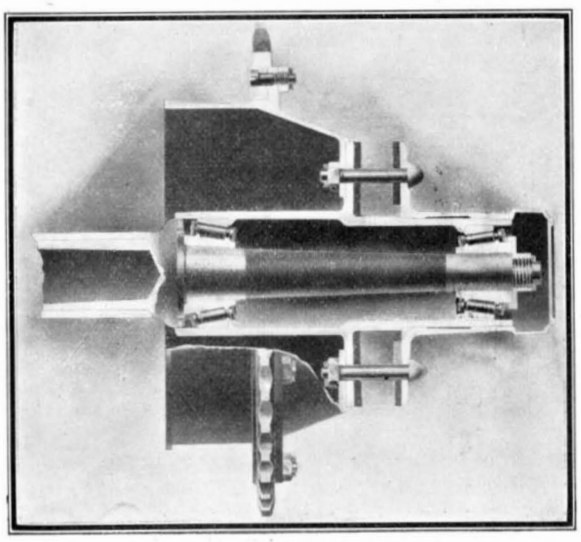


Fig. 4.—TIMKIN ROLLER BEARING IN REAR WHEEL HUB.

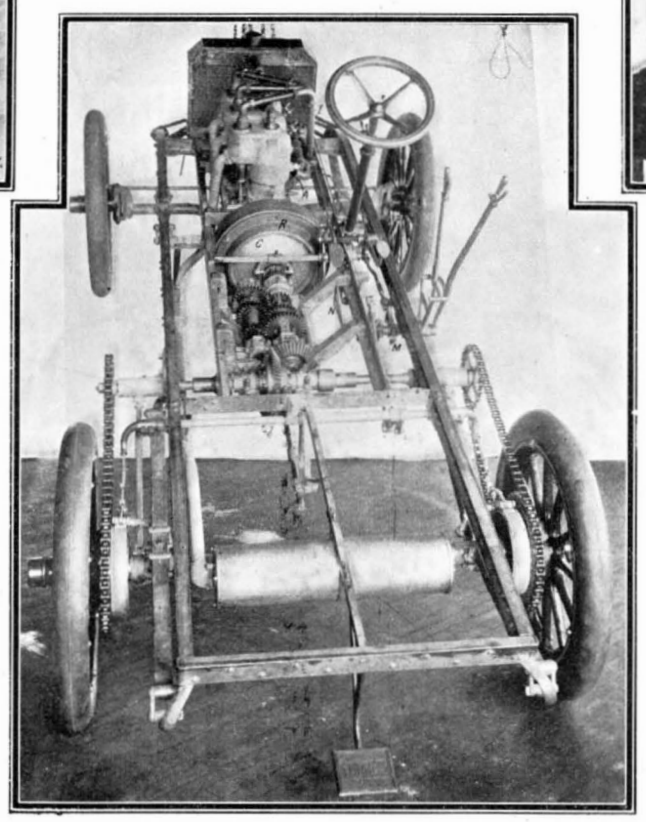


Fig. 6.—CHASSIS OF THOMAS CAR.

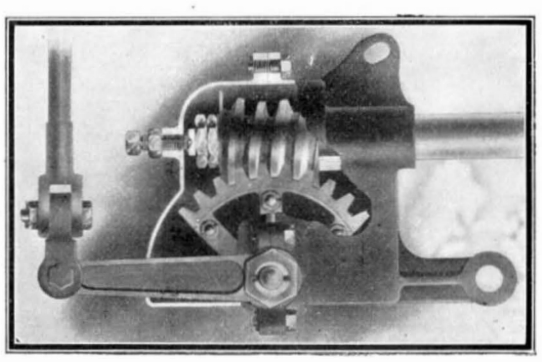


Fig. 5.—WORM GEAR STEERING DEVICE.

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when throwing in the high speed, it causes the toothed segment, *S*, to mesh with and turn a pinion on the end of the shifting fork lever, *T*, with the result that the gears 2 and 5 are moved to the right, so that they mismatch with 1 and 6, thus allowing the shaft, *B*, to remain idle. This is a refinement of the transmission gear which is found on but few cars as yet, but which will doubtless soon come into vogue, as it causes the machine to run very quietly on the high gear. The reverse is had by gear 4 meshing with an intermediate pinion below the gear 7 and in mesh with it. Chain oilers like that shown on the opened bearing of the transmission are used on all six of its bearings, as well as on the two end bearings of the motor crank shaft. These oilers consist of a small chain that dips in an oil well and, as it is carried along by the rotating shaft, brings the oil up on it. The three-cylinder motor is fed from a single carbureter of the constant level, spraying type, and exhausts into a single muffler in the rear. The mouth of the air suction pipe is seen at *A*, and the inlet pipe coming from the carbureter at *I*. The water pipes are seen on the top and sides of the cylinders, running direct to the honeycomb type of radiator. A belt-driven suction fan is arranged back of the radiator. The circulating pump is gear-driven from the motor crank shaft, and is of the revolving gear type. The cut of the motor, Fig. 2, shows the half-speed cam shaft that operates the exhaust valves. The inlet valves are automatic. The contact device is also seen in this picture, as well as the three spark plugs. The cranks are set at 120 deg., thus giving an explosion every two-thirds of a revolution. Adjustable bearings are provided between each crank, and are oiled by splash lubrication.

The sight-feed pressure oilers on the dash supply oil to the cylinders and end bearings of the motor, while the oil in the crank case needs renewing about once in 1,000 miles.

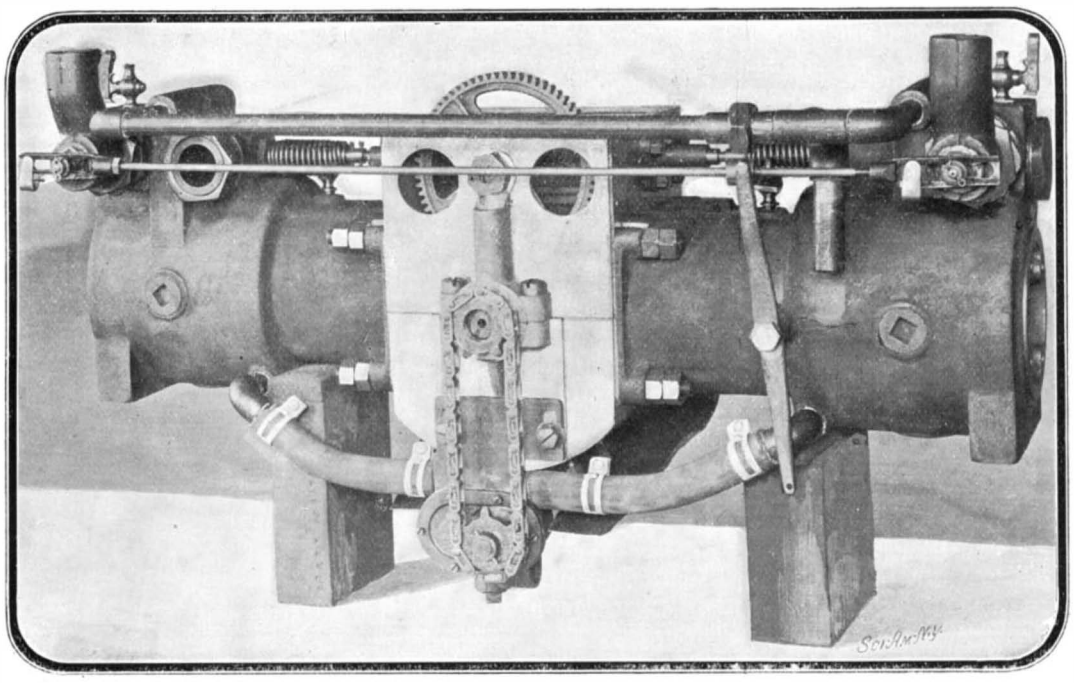
The countershaft is fitted with a band brake drum near each end, as shown in the detail picture. These drums were not in place when the photograph was made, nor was the belt-driven fan that is located behind the honeycomb radiator. Otherwise the view of the chassis is complete. The outside lever of the two shown at the side changes the gears, while the inside one applies the rear wheel brakes, at the same time releasing the clutch by means of a sector (*M*, Fig. 6) pushing a rod that depresses the clutch pedal. A longer sector, *N*, has holes in it, corresponding to the different positions of the gears. A rod rides on this sector and keeps the clutch disengaged while the gears are being changed. Not until the gears are properly in mesh does the plunger rod drop into the corresponding hole and allow the clutch to slip in. When the clutch has thus engaged, the gears can not be shifted till after the clutch has been released with the pedal. This locking device is one of the features of the car.

In closing, a word should be said regarding the workmanship and material entering into the construction of the Thomas machines. A visit to the company's factory will convince anyone that these are of the best throughout. The motor cylinders, after being cast, are tested for blowholes, and, if found perfect, are then bored, ground, and lapped. They are put in a special jig when the valve and lug holes are bored, so that these are always bored accurately, thus making the cylinders interchangeable. The gears of the transmission are all cut from solid stock, and have their teeth slightly beveled and thoroughly case-hardened. The whole mechanism of the car is assembled on a riveted channel steel frame and sub-frame of substantial construction.

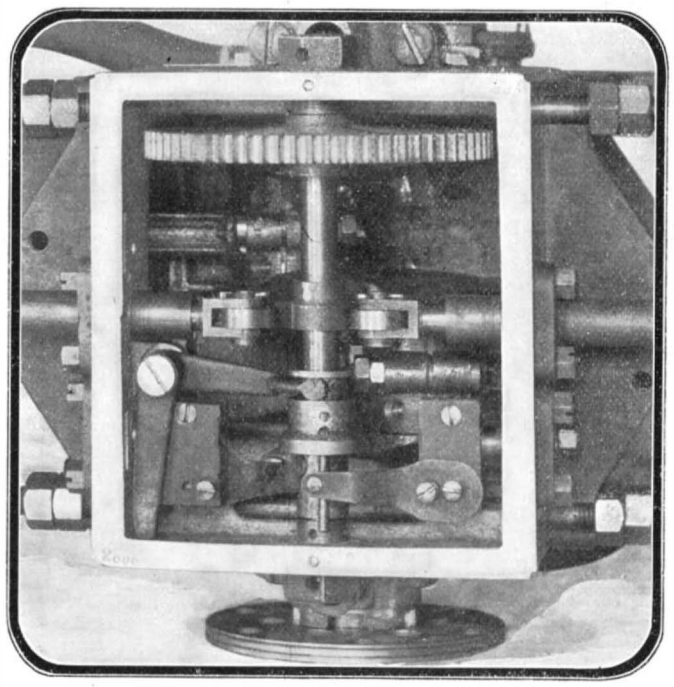
The general specifications of the car are as follows: Weight, 2,000 pounds; horse power, 24 brake; wheel base, 7 feet; tread, 56½ inches; tires, 4 x 34 Fisk detachable; speed of which car is capable, 45 miles an hour.

THE STEVENS-DURYEA GASOLINE STANHOPE.

The machine illustrated on this page is the result of many years' experience in the building of automobiles on the part of Mr. J. F. Duryea. It is a typical American runabout of the double, opposed-cylinder type, and besides its many good points and several novelties, it holds enviable records for speed, reliability, and rapid hill-climbing powers. A chassis of this type, driven by O. Nestman, made a mile on the Ormonde-Daytona beach recently in 57 1-5 seconds, thereby reducing the previous record for cars under 1,000 pounds by 9 seconds.



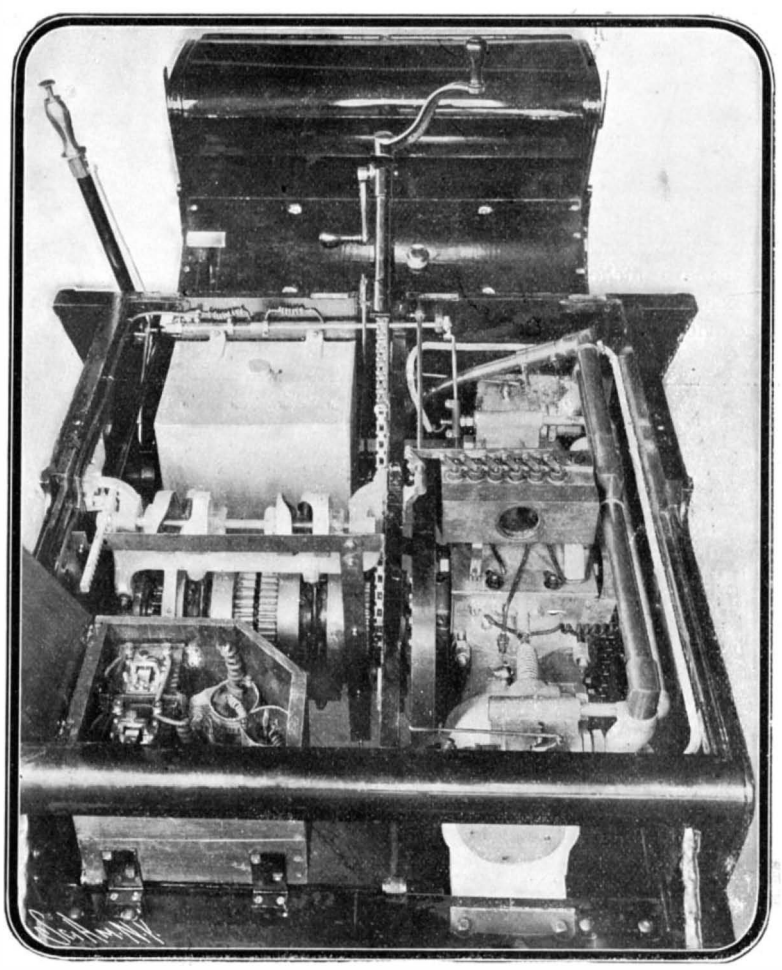
SIDE VIEW OF STEVENS DURYEA OPPOSED-CYLINDER MOTOR.



PLAN VIEW OF MOTOR CRANK CASE.

The side view of the motor shows the suction-operated inlet valves with their throttling device, consisting of long wedges that slide under washers on the valve stems and thus hold the valves from opening to their fullest extent. The wedges are connected and are operated by pressing a button in the end of the change-gear lever. The two-to-one gear can be seen projecting above the crank case, and the rotary pump driven by a chain is visible below the motor. The plan view of the opened crank case shows the exhaust valve stems fitted with rollers, and the ignition contact springs, one above and one below the cam shaft next to the bottom edge of crank case. These flat contact springs are insulated from the motor and connected to separate spark coils. Directly under the upper one in the sleeve slidable on the cam shaft by means of the bell crank in left-hand corner, is a rounded steel contact piece. A spiral slot in the sleeve and a pin on the cam shaft, projecting into this slot (seen at end of upper contact spring), makes it pos-

THE STEVENS-DURYEA ON A WINTRY DAY IN THE PARK.



ARRANGEMENT OF MECHANISM WITHIN THE BODY.

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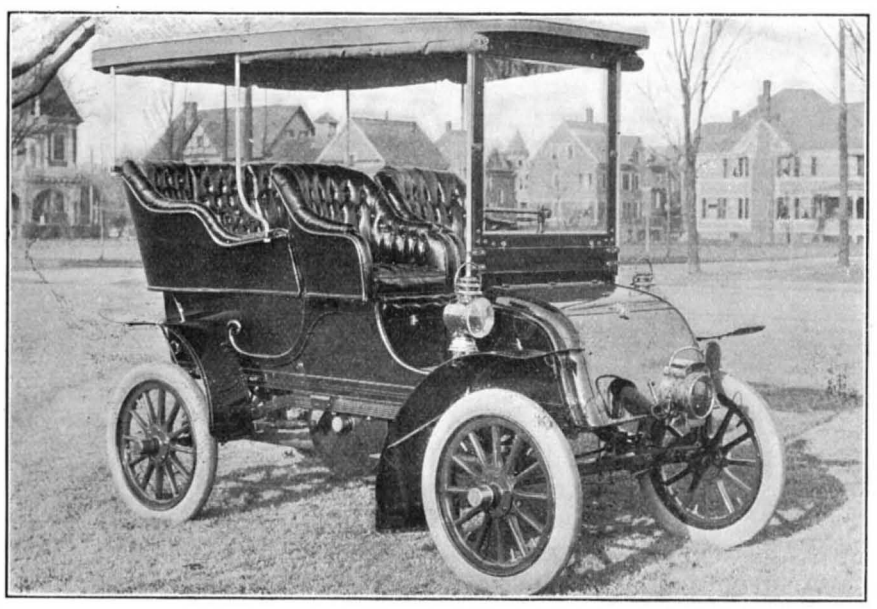
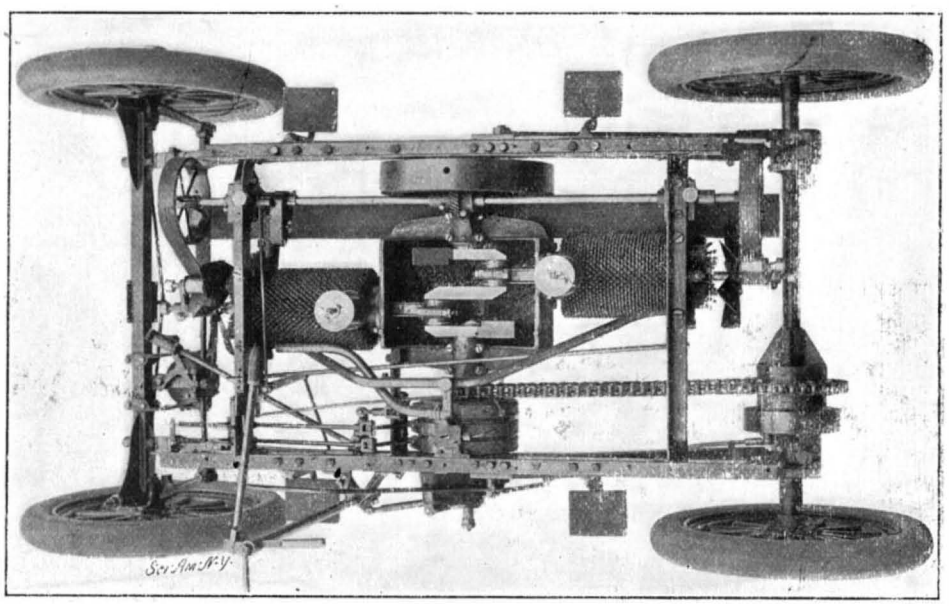
sible to advance the spark by moving the sleeve with respect to the shaft while they are rotating together. The bore and stroke of the engine cylinders are 4¼ and 4½ inches respectively, and 7 horse power is claimed for it at 700 revolutions per minute. This powerful motor weighs but 160 pounds, 78 pounds of which is in the flywheel. That this rating is conservative is shown by the car's performances. The cylinder heads of the motor consist of large caps that are screwed in with a special wrench. This makes it possible to remove the head quickly if for any reason the cylinder needs inspection. The disk at the bottom of the plan view picture is on the crank shaft and is bolted to a similar one on the transmission.



THE KNOX 16-HORSEPOWER TOURING CAR.

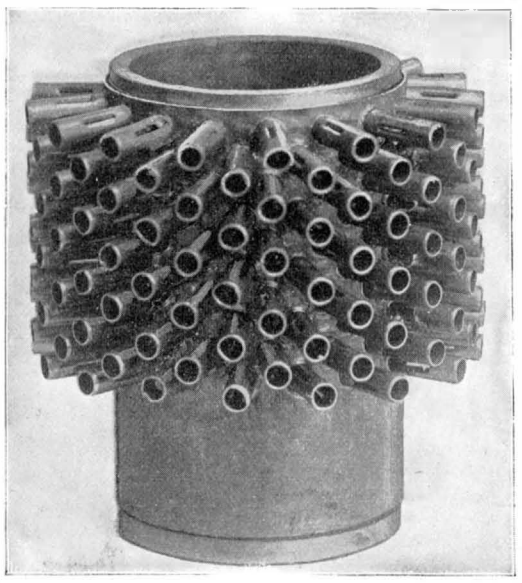


KNOX CHASSIS, SHOWING OPPOSED-CYLINDER MOTOR AND FANS.

The picture of the chassis shows the body, which is hinged at the edge of the front seat, tipped forward. The gears and their individual clutches are visible, as well as the specially shaped cams above them. These are operated by a rack and pinion, when the speed-change lever is moved, in such a manner as to throw in one clutch after another in their proper sequence, and yet, when the lever is moved from the third speed back to the "off" position, the second and first speeds are passed through without engaging the clutches. With the individual clutch system, which is used on very few cars, the gears are always in mesh and turning idly when the motor is running. The motor is set going from the seat by turning the small handle beside the steering lever. This is a very convenient feature of the machine. On the bottom of the steering post is a horizontal sprocket which is connected by a chain with a similar one on the front axle, the latter of course being connected so as to move the tie rod of the front wheel steering knuckles. The steering is sensitive and is geared down so that a slight movement of the handle will accomplish the desired result. The multiple oiler on top of the motor feeds all bearings and is turned on by a small handle in front.

THE KNOX DOUBLE-CYLINDER CARS WITH FAN-COOLED MOTORS.

After exhaustive tests throughout the past year, the Knox Automobile Company has now brought out a new line of tonneaus, surreys, and delivery wagons fitted with a 16-horsepower, 5 x 7, double, opposed-cylinder motor of their well-known, fan-cooled type, with which 1,760 threaded steel pins, 2 inches in length, are screwed into the surface of each cylinder to radiate the heat. This arrangement makes it possible to obtain 32 square inches of heat-radiating surface per square inch of outside cylinder surface, which is about four and one-half times that obtainable with the ordinary type of air-cooled cylinder with cast flanges; and it is for this reason that the Knox Company has been able to use a single cylinder of as large dimensions as 5 x 8 (the size used on the runabout) where most other manufacturers have heretofore not been able to go above 3¼ x 3½. The chassis of the double-cylinder cars is quite similar to that of the single-cylinder ones. It consists of an angle iron frame bolted down to the middle horizontal part of two reach springs that connect the front and rear axles. The front axle is a single trussed casting of a special aluminium bronze having a tensile strength of 60,000 pounds per square inch and also the property of bending rather than breaking. The rear axle is one solid steel shaft. It is keyed to the hub of the wheel on the end farthest away from the differential, and is supported in a Timkin roller bearing, while from the differential to the other end it passes through a sleeve which is keyed to one of the bevel gears in the differential, as well as to the hub of the nearby wheel, and which also runs in a roller bearing in the bearing box next to the differential. The reach springs are slidably and revolubly mounted in the bearing boxes; and each of the radius rods screws into a nut placed between two projecting lugs of one of the boxes. By unscrewing this nut with a wrench, it is backed off on the radius rod and carries the axle with it, since it pushes against the lug of the bearing box. This tightens the chain. The emergency brake is of the expanding ring type, the ring forming part of the bearing box and being cast of the aluminium-bronze alloy before mentioned.

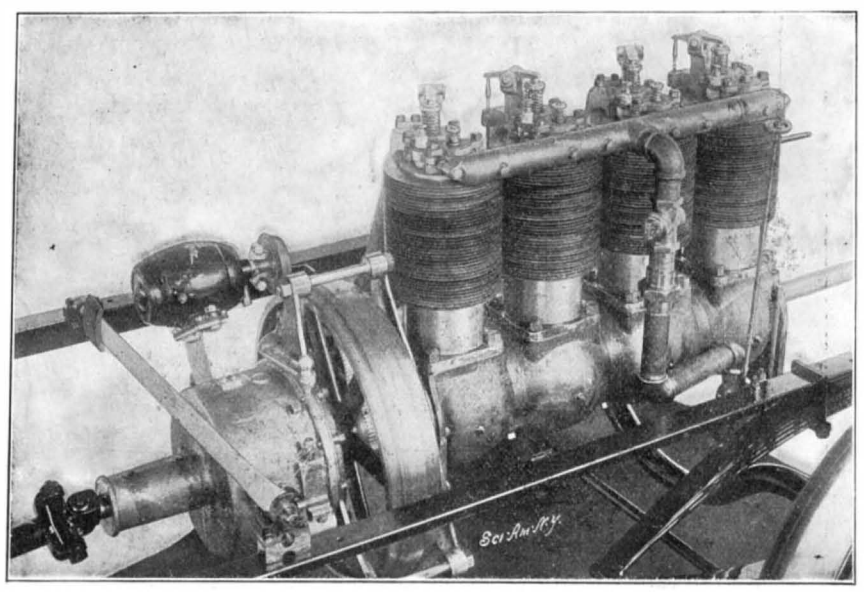


ARRANGEMENT OF SLOTTED TUBES ON REGAS CYLINDER.

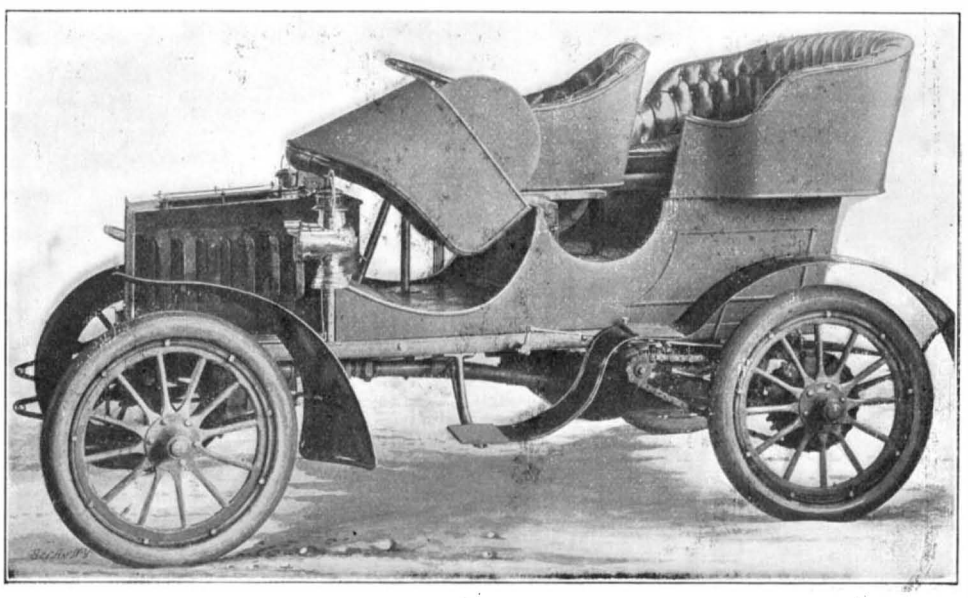
The other features of the Knox chassis can be seen almost at a glance, so simple in arrangement is the whole structure. The two cylinders are bolted to the cast-iron crank case, and are supported by four large cap screws that pass through holes in the cross members of the frame, and screw into lugs projecting from the cylinders. The heavy, 2-inch crank shaft, mounted in long bearings in the crank case, carries a flywheel on one end and the planetary transmission gear on the other. The three band brakes of the latter are, from the frame toward the motor, (1) the reverse drum brake, (2) the brake drum one, and (3) the low speed brake. The first two are operated by pedals, and the third by the handle projecting backward near the top of the steering post. The smaller handle, that projects outward, advances or retards the spark and at the same time opens or closes the throttle. The high-speed clutch consists of a ring of round hardwood blocks placed between two metal surfaces within the transmission, and clamped thereto when the clutch is thrown in. This clutch of small wooden blocks has been adopted in place of the expanding ring clutch formerly used. It is readily adjusted, and the wear upon it is slight. It can be slipped a good deal without burning the blocks, and it is unaffected by centrifugal force. Being within the transmission, it is completely protected from dirt.

The half-speed cam shaft is driven by a worm and spiral gear. It passes through bearings fitted with grease cups, near each end; and on each end there is a pulley for the fan belt, which is kept taut by adjustable jockey pulleys. These and the fan pulleys also are fitted with small grease cups. The contact box, seen on the cam shaft near the left-hand cross-member of the frame, contains a cam-and-spring make-and-break device of large size. Platinum-iridium contact points are used, which wear but little with long use. Besides the quart oil cups on each cylinder, which lubricate the pistons and hollow wrist pins, the motor has large grease cups on the flywheel end of the crank shaft (for the crank shaft and crank pin bearing on that end) and on the inner crank side member (for the other crank shaft and crank pin bearings and the transmission). The transmission is also oiled by squirting oil through small holes in the drum.

The regular Knox float-feed atomizer is used. It draws its air through small holes in the perforated



24-HORSEPOWER FRANKLIN AIR-COOLED MOTOR, SHOWING IGNITION DYNAMO AND TRANSMISSION GEAR.



REGAS 12-HORSEPOWER CAR WITH SIDE ENTRANCE TONNEAU AND 4½ x 5 TWO-CYLINDER AIR-COOLED MOTOR.

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pipe, that is placed beside the front cylinder, and feeds through the other branched pipe to the inlet valves of the motor. The exhaust of the motor is carried into the long muffler pipe *M*, which has perforations in each end.

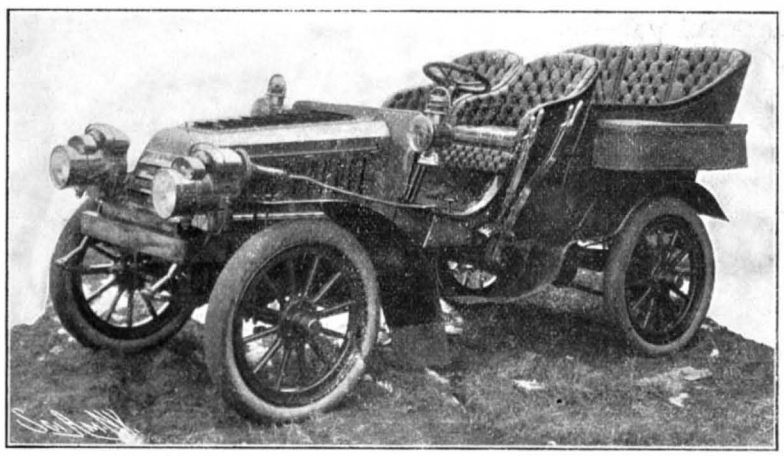
The tonneau model we illustrate is fitted with a substantial top having a glass front and side curtains. The glass front is similar to those used on the best European cars, and the driver, without leaving his seat, can unfasten it at the bottom by turning two thumb screws, raise it, and secure it against the canopy top. The car is well finished throughout, and that it does not belie its appearance is shown by the fact that two machines of this type, besides one of the single-cylinder cars, completed the most trying endurance run to Pittsburg last October.

THE REGAS AIR-COOLED AUTOMOBILE.

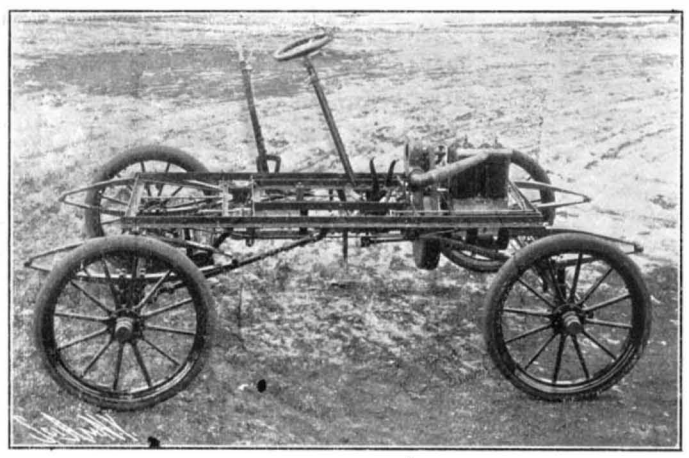
The air-cooled motor on the Regas cars is of distinctly novel design, as will be seen from the illustration. It is a two-cylinder motor with the cylinders set at an angle of about 45 degrees, an arrangement which is said to greatly reduce vibration and, in this instance, to allow of a better air circulation around the cylinders. The method of cooling the cylinder is new. It consists of clamping against it, by means of an outer sheet steel jacket, 172 slotted copper tubes, ½ inch x 1½ inches long. These tubes, it is claimed, not only have a large radiating surface, but they also act on the principle of the Bunsen burner, *i. e.*, the hot air passing out the end of the tubes draws in cold air through the slots. Thus radiation and air circulation are set up without mechanical means.

The light tonneau car with side entrance has a 4½ x 5, two-cylinder, V-motor, for which 12 horse power is claimed at a speed of 1,200 revolutions per minute. Each cylinder is oiled by a sight-feed oiler on dash, to which oil is supplied by the exhaust pressure. Splash lubrication is employed inside the crank case. The inlet valves are automatic and easily removable, and the exhaust valves, also, can be easily taken out. A four-cylinder 5 x 5 motor is also made for a large touring car.

The side-entrance tonneau is a novelty here, though it is much in vogue abroad. It offers all the advantages of the usual tonneau without the disadvantage of having to dismount in the muddy road instead of on the sidewalk.



THE MITCHELL AIR-COOLED FOUR-CYLINDER TONNEAU.



CHASSIS OF RUNABOUT, SHOWING BLOWER FOR COOLING MOTOR.

THE NEW FRANKLIN TONNEAU.

When the H. H. Franklin Manufacturing Company, of Syracuse, N. Y., brought out a runabout with a four-cylinder air-cooled motor about a year and a half ago, the automobile world was skeptical as to whether four 3¼ x 3¼ flanged cylinders arranged close together could be made to operate successfully. The endurance runs of the last two years—the New York-Pittsburg run especially—have nevertheless brought out the fact that an air-cooled motor of this sort can compete with motors of the water-cooled type, even under the most adverse conditions. That the Franklin Company's product is speedy as well as reliable has been shown on many of the race tracks of the country throughout the past season.

As the original Franklin car was anything but a failure, it is to be presumed the new 24-horsepower touring car, in which a four-cylinder, 4 x 5 motor with copper radiating flanges is used, has been thoroughly tested and proved successful by the company before putting it on the market. We understand a road test of 11,000 miles has been made, and this is of course good evidence that the motor works. On the new car the cylinders are arranged longitudinally on the frame, instead of transversely, as heretofore, and a fan is employed to aid in cooling them. The achievement of developing the air-cooled motor of the flanged type, which had been pronounced a failure by the French, and of bringing it to such a degree of perfection as to enable the use of as large a cylinder as is at present employed, should be credited to the Franklin Company. That others, realizing the advantages of air-cooled motors, are rapidly following this company's lead, is shown by the fact that over a half-dozen new firms are already in the field with air-cooled cars, some of which have distinctly novel methods of cooling.

The new touring car is a roomy "King of the Belgians" tonneau on precisely the same lines as the lighter runabout and tonneau which we have illustrated heretofore, with the exception noted above as to the arrangement of the motor. The planetary gear transmission is arranged in an oil-tight case attached to the crank case of the motor. It gives a speed reduction between the motor and the 32-inch wheels of 3½ to 1 on the high speed, 10 to 1 on the low speed, and 20 to 1 on the reverse. A universally-jointed shaft and bevel gear drive transmits power to the rear axle. The engine is fitted with hand control on the steering column by means of spark and throttle, and the car can be run from 4 to 40 miles on the high gear. Its weight complete is 2,000 pounds. It is fitted with roller bearings, and 4-inch detachable tires. Its tread is standard, and the wheel base is 96 inches. Fuel sufficient for a 150-mile run is contained in a 14-gallon tank.

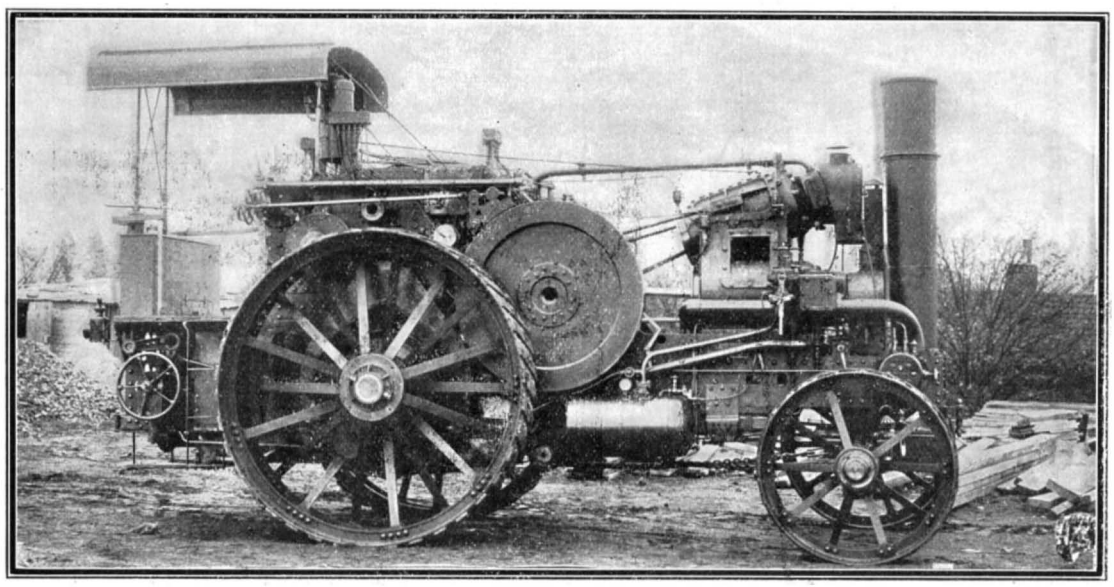
THE MITCHELL AIR-COOLED CARS.

Another firm to bring out a touring car with an air-cooled motor is the Mitchell Motor Car Company. Our illustrations show the chassis of this company's two-cylinder runabout, and the new four-cylinder tonneau car. The runabout model has been tested thoroughly the past season, and is said to have given satisfaction. The system of air-cooling employed consists in directing the draft from a rotary blower upon the cylinder heads of the motor. The blower is driven by a belt from the flywheel, which is large and heavy considering the size of the motor. The bore and stroke are 3½ x 4 inches, and the motor is rated as giving 7 brake horse power at 1,200 revolutions per minute. The cylinders are fitted with plain copper radiating flanges and are mounted on an aluminium crank case. The motor and transmission are oiled from a row of sight-feed oilers on the dash, to which the oil is forced from the oil tank by the pressure of the exhaust gases when the motor is running. As soon as it stops, the oil ceases to flow. Jump spark ignition by means of dry batteries is employed. An improved contact maker is used, and it is so placed that it is impossible for the points to become fouled with oil or dirt. The muffler has a cut-out, so that the explosions can be heard when desired.

The transmission gear is of the sliding type, giving three speeds ahead and reverse. There is the usual cone clutch in the flywheel, and the shaft connecting it with the transmission has a universal joint, according to the latest practice. The runabout has chain drive to the rear axle, and the tonneau to each rear wheel. The bodies are easily removable from the channel steel frames. The tonneau weighs 2,400 pounds and is a particularly roomy car.

THE PRIZE-WINNING MILITARY TRACTOR OF THE BRITISH WAR OFFICE.

The premier prize of £1,000 which was offered by the War Office some months ago for a traction engine suitable for military purposes, has been awarded to Messrs. Hornsby & Sons, Limited, of Grantham. The conditions were that the engine should be capable of hauling a gross load of twenty-five tons over a distance of 40 miles at an average speed of 3 miles an hour over ordinary roads and hills, without taking fuel or water on board. The weight of the engine, fuel, and water was not to exceed thirteen tons, and the engine must also be able to travel in case of necessity at a maximum speed of 8 miles an hour. The conditions of weight and space were so difficult that ordinary steam engines were practically debarred from competing, being unable to travel further than 10 or 12 miles without taking a fresh supply of fuel and water. Hornsby & Sons, in fact, was the only firm that was able to build an engine calculated to fulfill the conditions. It was propelled with an oil engine of the Hornsby-Akroyd type, constructed on the lines of an ordinary traction engine, spring mounted at both ends, and fitted with the usual speed-change gears. In the course of the trials at Aldershot the engine fulfilled every requirement, and not only carried off the first prize of £1,000, but also gained bonuses amounting to £180 in consequence of being able to travel a distance of fifty-eight miles without a stop for fuel and water, £10 per mile being offered for every mile thus covered beyond the forty miles stipulated.



THE PRIZE-WINNING MILITARY TRACTOR OF THE BRITISH WAR OFFICE.

Formetal—A New Metal Possessing Great Resistance to Rupture.

The automobile industry, always up-to-date with novelties, is beginning to employ, for the construction of parts which must be able to resist great pulling or twisting strains, a bronze unalterable by the air or even weak acids, and which has been given the name "Formetal."

Its inventor is M. Henri Nouri, engineer E. C. P., late vice-president of the Committee of Copper Founders. The alloy contains, besides the normal elements of bronzes and brasses, other metals of high mechanical resistance, which constitute with the first a veritable chemical combination. It can be cast perfectly, rolled, and drawn in bars of any outline desired.

The tests of resistance which were made on bars of this metal at the Conservatory of Arts and Trades and under the supervision of the French Navy Department, have given the following results, which are remarkable for pieces of cast bronze: Resistance to breakage: 43 kilogrammes per square millimeter; or, 6.12 pounds per square inch. Elastic limit: 27 to 28 kilogrammes per square millimeter; or 3.84 to 3.98 pounds per square inch. Lenthening: 40 per cent.

The metal, drawn in bars or rolled and forged, resisted rupture under pressures up to 60 kilogrammes per square millimeter (8.53 pounds per square inch) with a lengthening of from 24 to 25 per cent.

This metal can be worked with ease in a lathe. It is suitable for the manufacture of unoxidizable nuts and screws, part of the electrical equipment, very strong supporting brackets for carbureters, and parts of the change speed gear.

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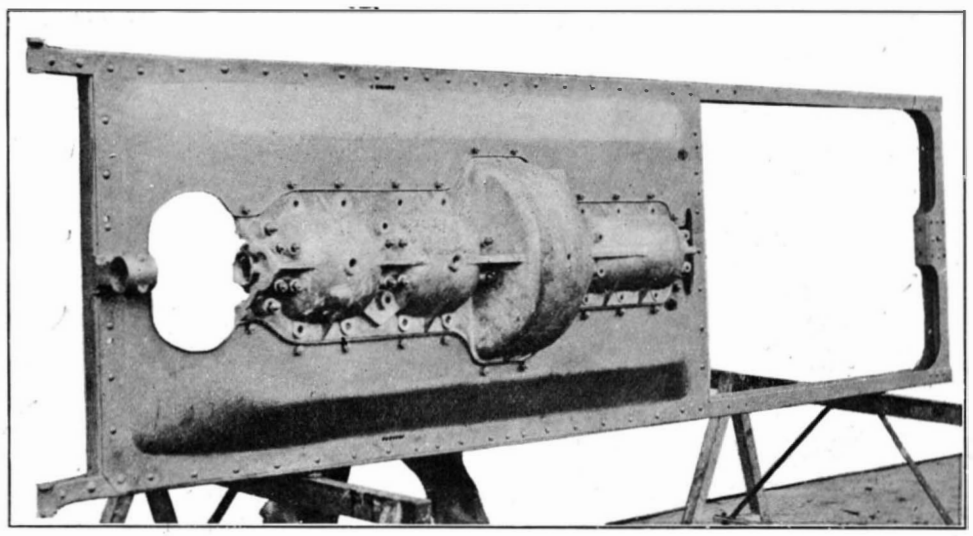
THE PARIS AUTOMOBILE SHOW.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Although the Sixth Annual Automobile Show, which terminated on the 25th of December, was doubtless the most pretentious exhibition of motor cars that has ever been held in Europe, it must be confessed that little, if anything, radically new was exhibited. As a whole, the vehicles which crowded the main floor of the Grand Palais, and almost every nook and corner of the huge building, showed general progress in the perfection of details, with an occasional noteworthy construction. Among the most remarkable exhibits, must be mentioned an admirable collection of automobile boats, which showed how rapid has been the progress in this particular branch of automobile engineering within the past year.

Among the more striking novelties exhibited was a frame containing a bicycle motor and all its accessories. The inventor has christened this product of his ingenuity, the "Motosacoche." Six wing nuts, *V*, as shown, attach the motosacoche to any bicycle. In the accompanying illustration, the gasoline tank is lettered *G*, the spark-coil *S*, the batteries *B*, the carbureter *C*, the oil-tank *O*, the motor-cylinder *A*, and the contact-box *D*. A jockey-pulley, *J*, keeps the belt taut. The muffler, *M*, is mounted below the motor. The spark and throttle levers, *H*, are attached to the handle-bar, and are connected with the motor by flexible cords. A twisted belt passed about a grooved pulley, clamped on the spokes of the rear wheel, serves to transmit the movement of the motor shaft. In order to draw the air past the horizontal flanges on the motor-cylinder, the motor is incased by two side covers, bulged in front to form a scoop. Not the least striking feature of this entire appliance is its light weight. The motor weighs but 15½ pounds, and develops 1¼ horse power. The carbureter, which uses either gasoline or alcohol, weighs about 9 pounds. Two cells of storage battery supply current for the ignition. The connecting wires are clamped against the lead terminal lugs, instead of being fastened with brass binding-screws, thereby avoiding oxidation and obviating the breaking of the lugs. The gasoline tank, with its capacity of 3 pints, contains enough fuel for a journey of 100 kilometers (62.1 miles). Oil is forced into the crank-case by a hand-pump, contained in the oil-tank *O*. Sufficient oil is carried for a trip of 124 miles. The weight of the bicycle is increased but little by the addition of the motosacoche, since the total weight of the whole mechanism is but 66 pounds. Of the efficiency of the appliance it may be said that in a 1,000-kilometer (621 miles) endurance test for motor bicycles, two machines equipped with motosacoches won first and second prizes.

Of the light cars, among the more prominent exhibited were the Renault vehicles, one of which made such a brilliant record in the Paris-Madrid race. The Renault car is built either as a light car or as a voiturette, using a four-cylinder or a two-cylinder motor, as the case may be. Otherwise, the general disposition of the parts is much the same in each. The accompanying illustrations depict one of the latest Renault voiturettes. The designs of the motor, the gear box, and the differential, are similar to last year's type. A number of important changes, however, may be found in the minor parts—changes which have contributed not a little to the success of the racing car. Of the light car using the four-cylinder motor, it may be said that its carbureter is of the float-feed, atomizer type, combined with a revolving valve for regulating the air admission, and with a second valve for admitting a greater or less quantity of the explosive mixture to the motor cylinders. A complete description of this carbureter, as well as of other novel features of the Renault machine, will be found in the SCIENTIFIC AMERICAN SUPPLEMENT of January 30, 1904. It may be mentioned that one of the novelties which has been specially remarked in this year's type is the device employed for operating the inlet valves of the motor. Departing from a practice which is coming much into vogue, the valves are not operated mechanically. They are, nevertheless, arranged so as to offer a greater or less resistance to the admission of gas by means of a device which is mounted on the valve, and which is suitably connected with a small lever underneath the steering-wheel. In this way, the admission of gas to the motor is varied, without using a throttling-valve on the inlet-pipe. The ignition devices comprise the usual accumulators, induction-coils, and spark plugs, arranged, however, so as to use only one-half the number of parts ordinarily required for a four-cylinder motor. The Renault chassis, which have been lengthened to accommodate the new-style bodies, are of three different types, for 7, 10, and 14 horse power respectively. The transmission consists of two parallel shafts, the main shaft being in line with the motor crank-shaft and made in two parts which can be joined through miter gears, for a direct drive on the high-speed. For the first and second speed and the reverse, the miter gears are separated.



NEAR VIEW OF APRON RIVETED TO FRAME AND HOLDING COMBINED MOTOR AND TRANSMISSION GEAR CASES.

Still another novel vehicle exhibited at the show, which deserves more than passing attention, is the Delahaye touring car. The chassis is well pictured in the accompanying illustration. The four-cylinder motor develops 24 horse power at 1,100 revolutions per minute. One of the improvements of the 1904 model is a new carbureter, of which the details have not as yet been made public. In front, the governor, the water-pump, and the ignition contact-box are compactly mounted. The first two are driven from a gear on the end of a main cam-shaft; while the ignition-box is fixed on the end of the same shaft. The governor acts upon the carbureter by means of a lever and spring. As soon as the flywheel clutch is thrown out, the speed of the motor rises, and the governor balls fly apart, thereby operating the lever and cutting down the gas inlet. Another novelty of the Delahaye automobile is a new gear-changing box with a double sliding gear. The Delahaye automobile launch motor was another novelty that attracted some attention. For the purpose of securing ready access, the crank-case is opened on a hinge at one side. The present motor has two cylinders and yields twelve horse power running at 1,200 to 1,500 revolutions per minute. The gas inlet is varied either by the governor or by hand. The transmission is distinguished by the use of a cone-clutch combined with the differential in such a way that, by tightening a band brake upon the differential, the auxiliary bevel gears of the latter are blocked and the shaft is turned in the reverse direction.

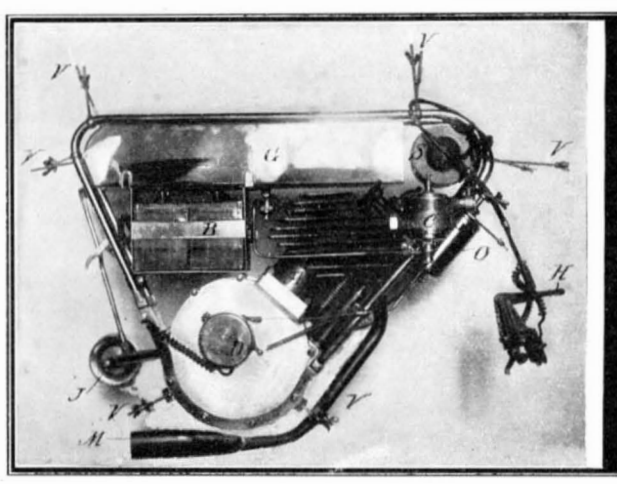
The Fouillaron automobile, which also formed a noteworthy exhibit, uses a pair of extensible pulleys to transmit the movement from the motor to the rear, thus dispensing with the change-gear-box. The two extensible pulleys are connected by a leather belt of special construction. The pulleys are formed of two conical wheels, the spokes of which fit into each other like the interlocking fingers of two hands, thereby forming a pulley of triangular section. One of the halves is movable. By sliding it back and forth, the diameter of the pulley may be varied at will. The same lever shifts both pulleys, increasing the size of one and decreasing that of the other, thus maintaining the belt length constant. In this way, the speed of the car may be easily varied without the friction loss of ordinary gearing. Instead of the three or four speeds which are obtained in the usual transmission, the speed may be varied gradually and without shock within the speed limits.

A 150-horsepower Fiat motor for submarine boats was the object of more than one admiring group of spectators. The motor is of the four-cylinder pattern, and makes 600 revolutions per minute. Since it is difficult to start a very large motor, a dynamite cartridge is used, the explosive force of which supplies the initial impulse. A magneto is employed to produce the ignition-spark. The moment of ignition may be varied as the magneto is driven by special gearing on the main cam-shaft. The gear is mounted so as to be displaced by the action of the governor-balls. In this way, the relative position of the armature to the motor stroke is varied according to the motor speed. The second cam-shaft in the rear carries a ball-governor, which acts upon the inlet of gas to the motor.

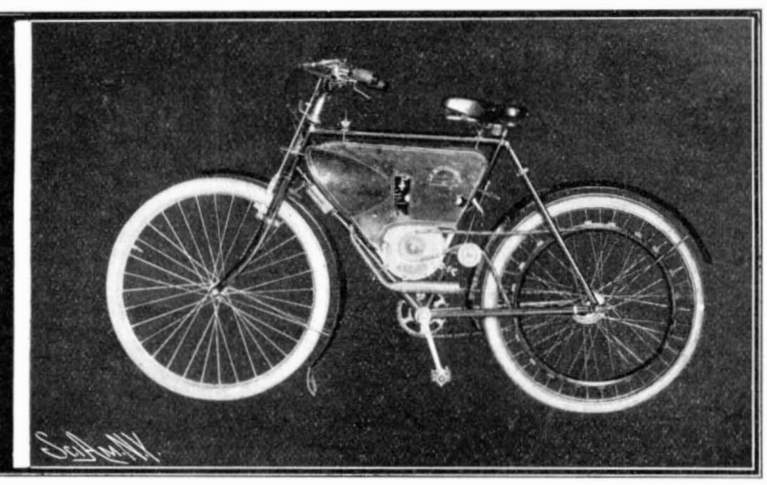
A method of automobile construction designed by the Decauville Company is illustrated in the engraving annexed. The main feature of the construction resides in the use of a single casting to form the lower half of the crank-case and gear-changing box. In most automobiles the motor is mechanically separated from the gear-box, and by reason of the shocks of the road, each of these parts, the heaviest on the car, is likely to take a different movement, thereby subjecting the mechanism to unequal strains. In the present construction, this difficulty is overcome by building the motor crank-case and the gear-box in a solid piece, so as to avoid any displacement between them. The arrangement gives absolute rigidity in the transmission of the power to the rear, no matter what may be the jarring of the chassis on the road. A large stamped steel plate, riveted to the channel bars which form the frame of the chassis, acts as a support for the mechanism.

The Darracq Company have gone one step further and have brought out a complete pressed-steel frame like the Decauville, but with the apron, by which the engine and transmission are held, integrally formed with the frame instead of riveted to it. The Darracq frame is a good example of the possibilities of pressed or stamped steel construction in automobiles.

In the SCIENTIFIC AMERICAN SUPPLEMENT of January 30, 1904, will be found a complete account of the show, to which account the reader is referred for description of details.



THE MOTOSACOCHE.



MOTOSACOCHE ATTACHED TO A BICYCLE.

Complete statistics from 85 per cent of the automobile manufacturers in the United States to September 3 indicate that the actual sales for the year 1903 will be 11,000 cars, valued at $12,000,000. This is double the business of 1902, to which must be added the foreign importation of 200 cars, valued at $800,000. The importation of foreign cars is about the same as last year. Trade in foreign-made cars is probably at its maximum and will slowly decline, as the American manufacturers are rapidly supplying the demand.

There has been exhibited in London a diamond, which is the second largest gem of its description in the world. It weighs 336½ carats. It is of a yellowish color and worth about $10,000. If the color had been better, the stone would have been worth a fabulous amount. It was recently extracted from the Ottos Kopje diamond mines at Kimberly.

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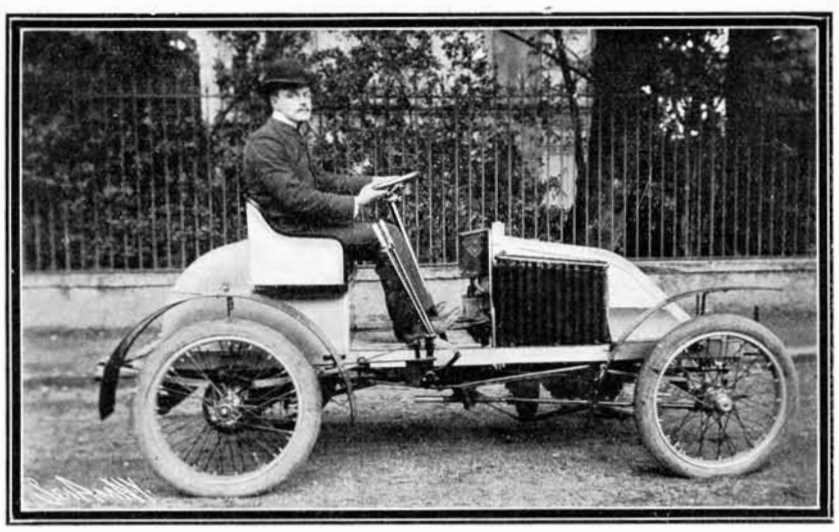
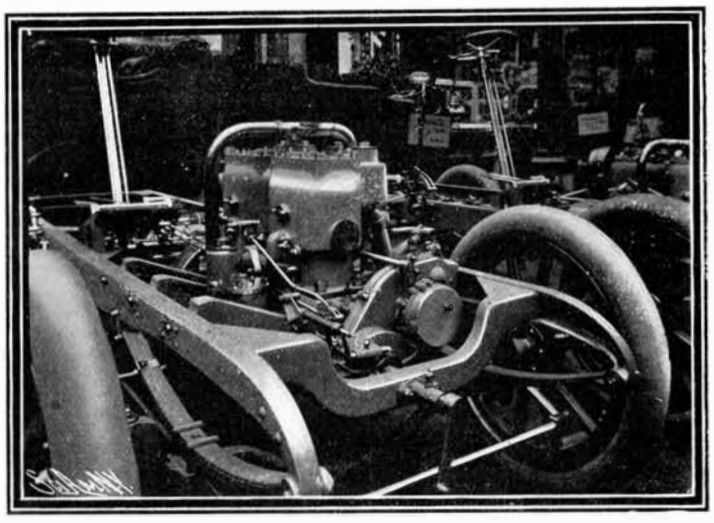
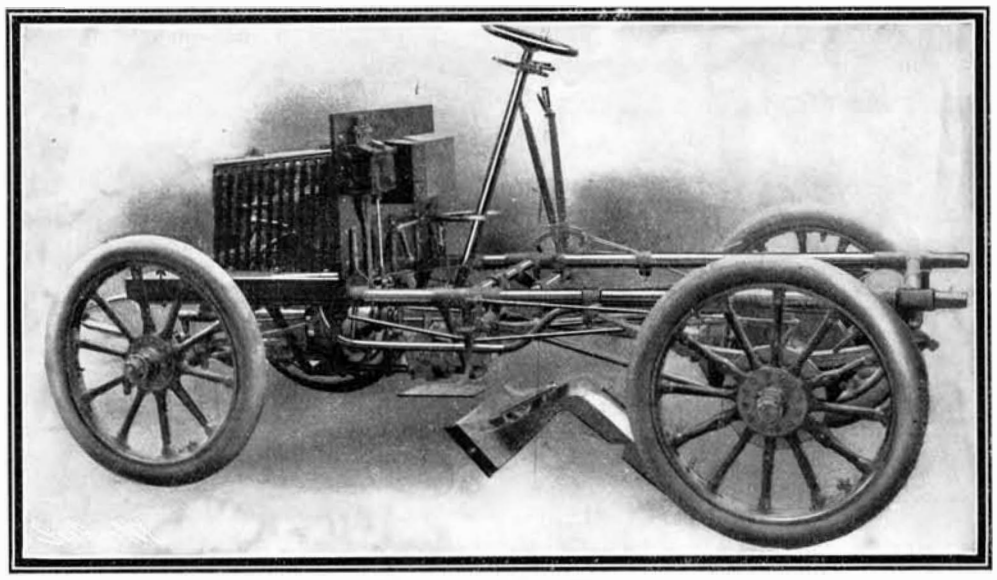


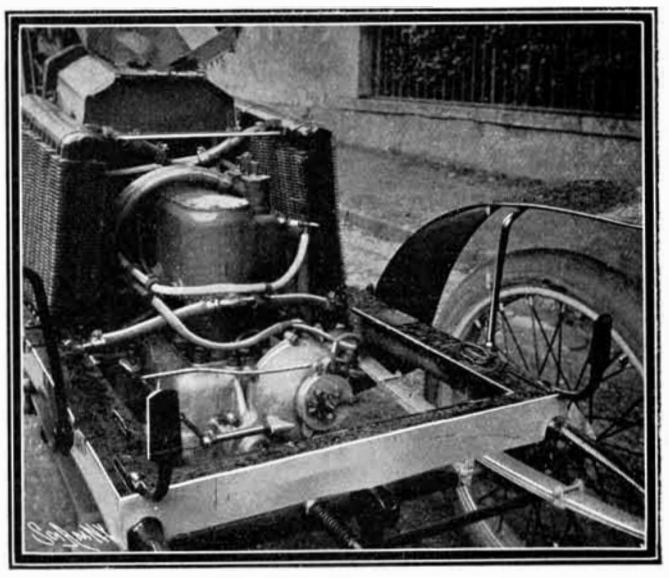
Renault Voiturette.



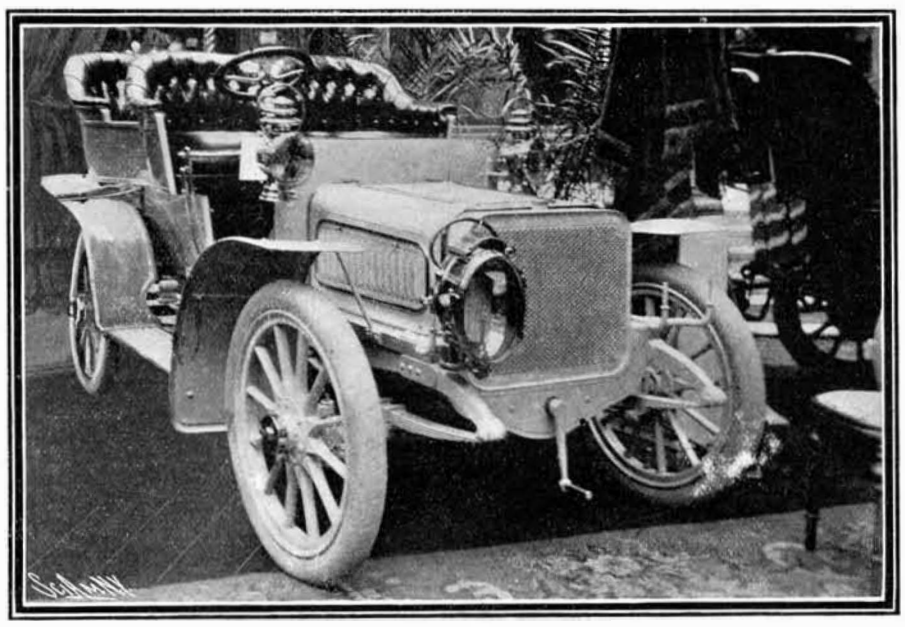
Chassis of Delahaye Touring Car.



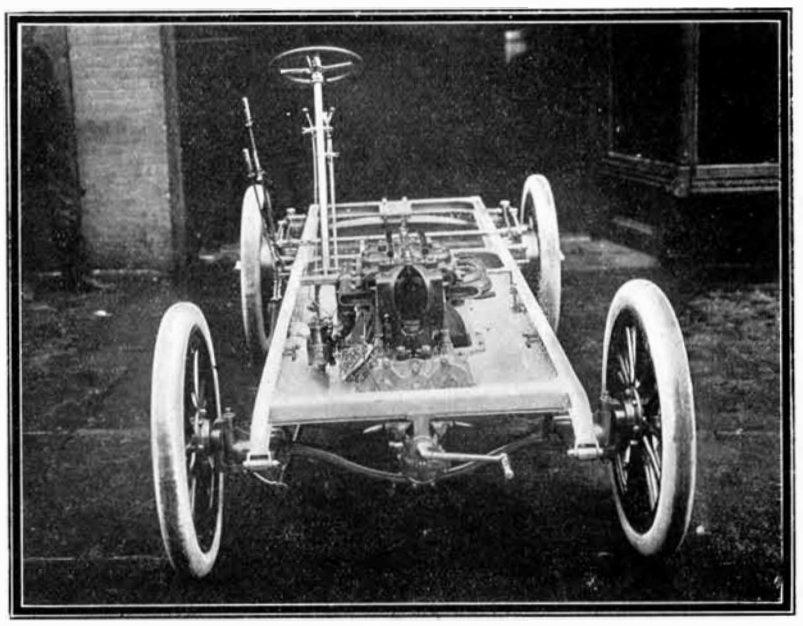
Chassis of 7-Horsepower Renault Car.



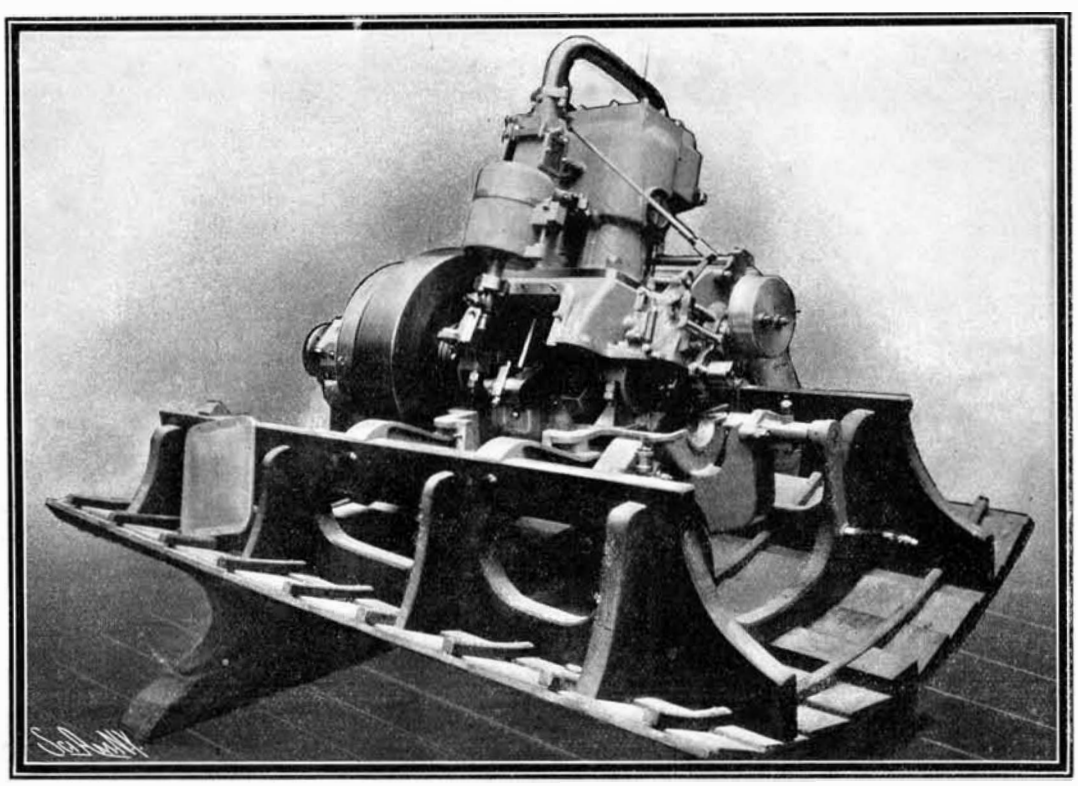
Renault Twin-Cylinder Motor.



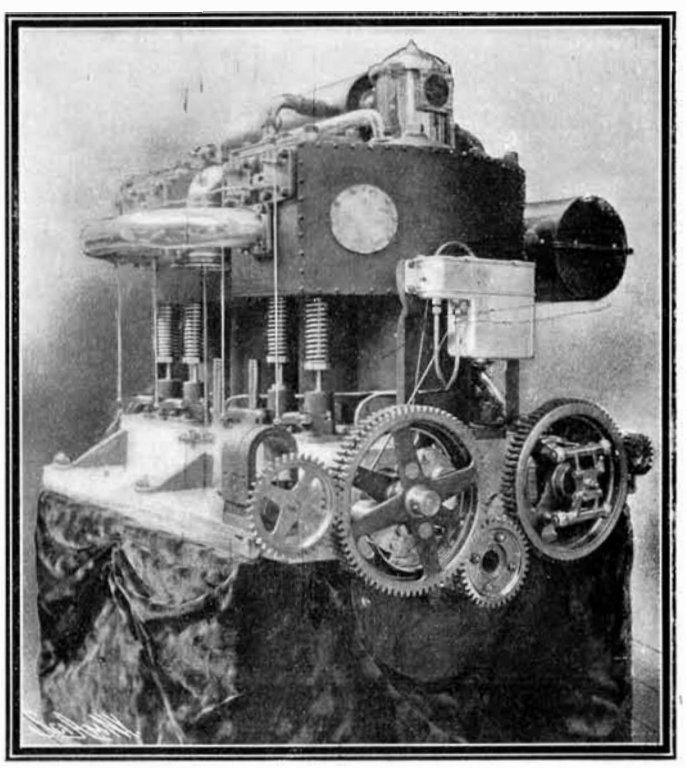
Decauville Touring Car.



Chassis of Decauville Car.



Delahaye Launch Motor, Showing Hinged Crank Case.



150-Horsepower 4-Cylinder Flat Motor for an Italian Submarine.

SOME EXHIBITS AT THE PARIS AUTOMOBILE SHOW.

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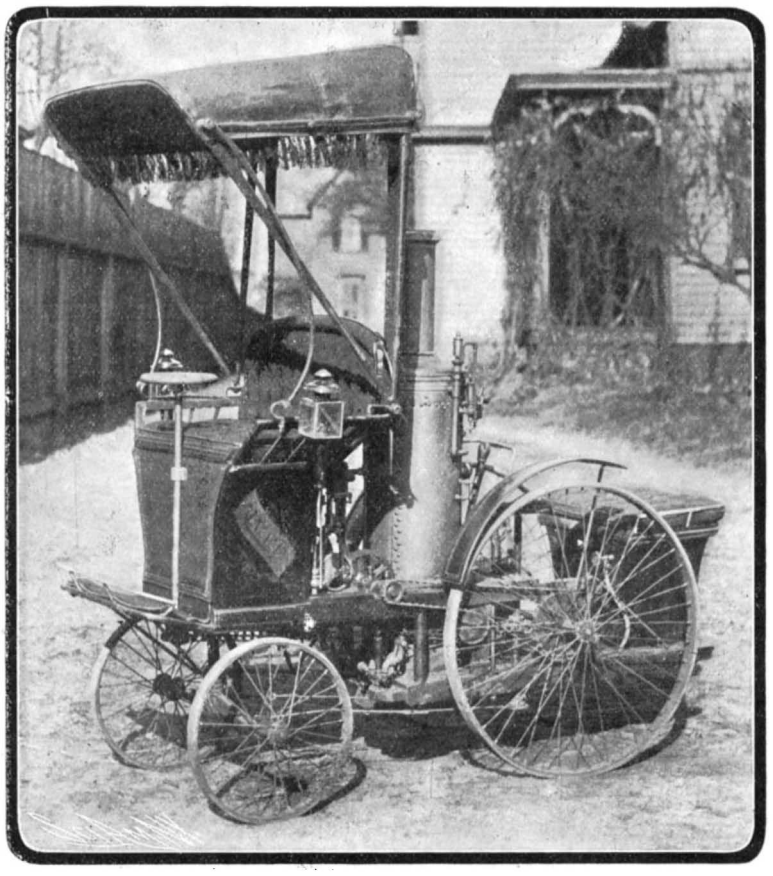
AN INTERESTING AUTOMOBILE RELIC.

The automobile curiosity which is shown in the accompanying photograph was built in 1890 by its present owner, several years prior to the general introduction of horseless carriages in this country. It is owned by Achille Philion, of Akron, Ohio, who keeps it in his barn, treasuring it as a relic. The machine complete weighs about 550 pounds, and is of 1 horse power. At first the machine was steered from the rear seat, but later was so arranged that it could be steered from either front or back seat. It was patented in 1892, and was named "Philion's steam road-carriage."

This automobile was built after the ideas of Mr. Philion. However, as he was neither a machinist nor a carriage builder, the work was done by others. The upright engine and the boiler were made by a manufacturer of fire engines. At the time that the automobile was being built, Mr. Philion was traveling from place to place. He took the uncompleted machine with him. During his stay in various cities he hunted up a new machinist, and kept the work progressing under his personal direction. When completed, he used the machine in his travels in the West Indies, Canada, and the United States. It is in good working order to-day, but Mr. Philion has a modern machine which he prefers to use.



A STEAM CARRIAGE OF THE YEAR 1890.

THE IVEL AGRICULTURAL MOTOR.

For two years there has been at work in England a new portable petrol agricultural motor, the invention of Mr. Dan Albone, of the Ivel Motor Works, Biggleswade, Bedfordshire.

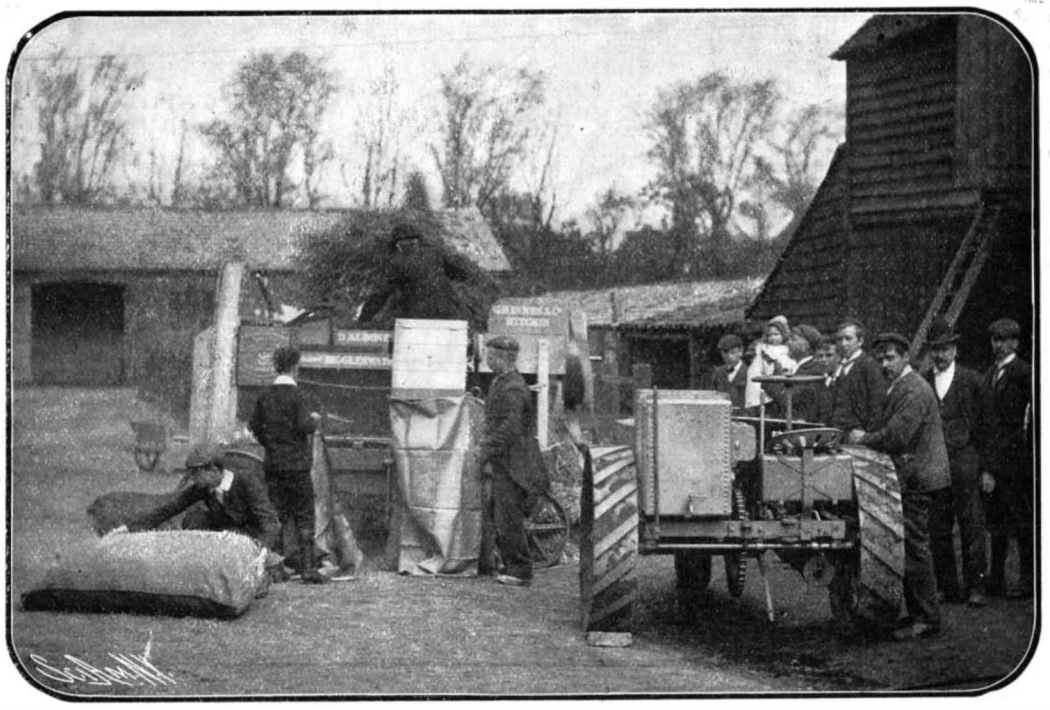
This new motor has been designed and made chiefly for the use of farmers. It is constructed to draw motors, reapers, plows, scuffles, wagons, etc., by attaching these machines to the back of the motor. The connection is formed by taking out the long pole of the mower, and substituting a shorter one, the latter being joined to the motor by a spring coupling. Almost any agric ltural machine can be attached to the motor in a few minutes, and apart from working in the field it can be utilized on the farm for cutting chaff, pulping roots, grinding corn, and other operations.

The petrol motor is an 8 horse power double cylinder with water circulation. It has electric ignition, one speed forward and reverse, and it is claimed that any ordinarily intelligent farm hand could drive it after a few lessons. The engine is free, and when put in motion a friction clutch is employed to transmit the powe through an intermediate shaft to the balance gear shaft of road wheels, by means of patent silent-running chains. The wheels have extra wide rims with grips on to prevent them from skidding round. The machine complete weighs 17 hundredweight, 7 pounds, and for traveling on the high-road detachable rubber pads are attached to the rims of the wheels by means of thumb screws. These rubber pads lessen the vibration and enable the motor to run more silently than it would do otherwise.

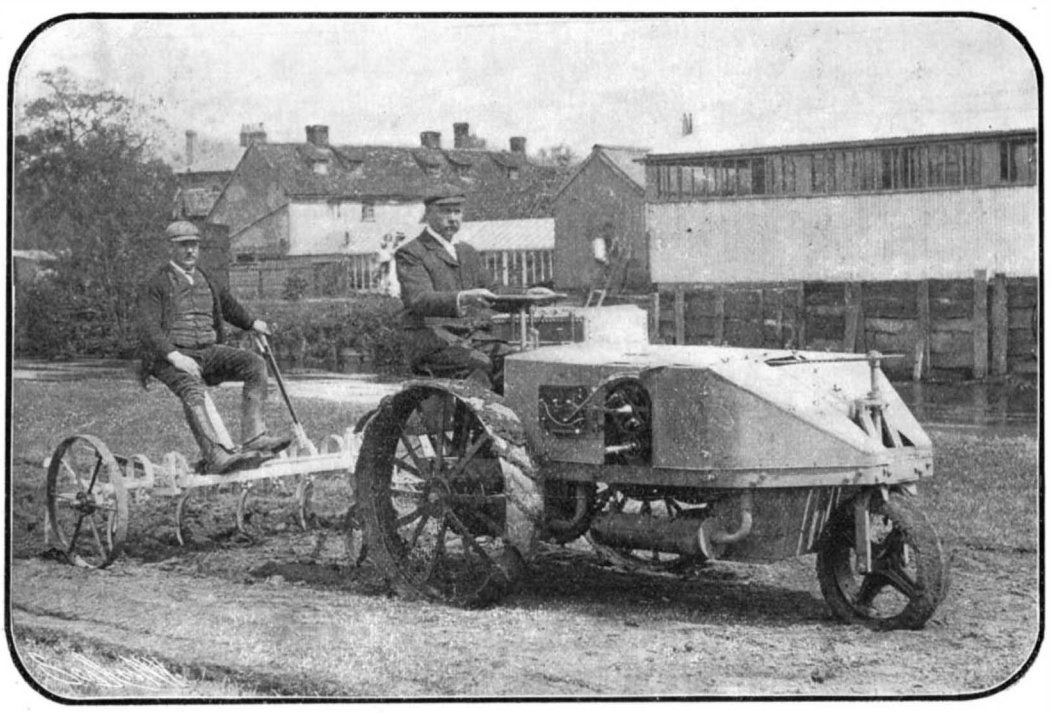
They are easily fitted or taken off in a very short time. The cost of fuel and necessities in running the new agricultural motor is very small and Mr. Dan Albone claims that it works out considerably less than the cost of horse labor.

The Ivel agricultural motor has been employed in harvesting operations in Bedfordshire, Lincolnshire, and other English counties. The motor attached to a Hornsby 6-foot reaper and binder cut heavy crops of wheat and it was found that the cost of fuel worked out at about 8d. an acre and that less time was taken than formerly when horse labor had been employed. Besides this, two horses and a man were dispensed with, for the motor requires only one man to manipulate it.

The Ivel motor also cut a field of barley, and after cutting the crop it drew the loaded wagon from the field. In order also to prove its capabilities Mr. Dan Albone attached a two-furrowed Hornsby plow to the motor and a piece of oat stubble land was plowed. The work was declared by farmers, who witnessed the trials, to be exceedingly well done, the furrows being even and of good depth. Martin's cultivators were also tried attached to the motor and the work in this case was equally well done. The motor plow can easily cut two furrows in one operation, about 20 inches wide and 5 inches deep. There is no doubt that in agricultural operations there is a great future before the mechanically-propelled vehicle. Hitherto in Great Britain the stationary engine has been almost exclusively employed, though in some places traction engines are used to haul plows, mowers, reapers, binders, etc., across the fields. The motor in the field itself running up and down the land is a new departure in England, and there is no doubt that such a motor as the Ivel will prove of very great value to the farmer. There is much agricultural depression in Britain, yet it was estimated that last autumn there were more than six and a half million acres of wheat, barley, and oats to be reaped, to say nothing of nearly eight million acres of hay to be cut in England alone.



THE IVEL MOTOR DRIVING A THRESHING MACHINE.



THE IVEL MOTOR HAULING A SCUFFLE.

A description of some canal boats fitted by the Gasmotorenfabrik Deutz with internal combustion engines of the ordinary stationary type for propulsion purposes is given by Braeuer in Motorwagen. The article, which is well illustrated, deals first with a barge, the "Haldy II.," having three screws, one of which is central and hinged, enabling it to be raised or lowered by means of a screw winding arrangement. The side screws are placed high up, and are alone used when the barge is loaded, the central screw being idle and raised to its highest position. When empty, on the other hand, the side screws are quite out of the water and the central screw lowered and used for propulsion. The engine is a horizontal oil engine of 16 horse power, using benzine, giving, with a useful load of 270 metric tons, 3.4 kilometers per hour. The engine is placed longitudinally in the center of the boat, and drives, by a belt, a transverse countershaft, this driving, by bevel gear, the two side screws. The blades of these screws are pivoted, and can be turned by a hand wheel so as to act in the reverse direction for going astern. When it is desired to work the central screw, the belt is shifted on to another pulley. Another barge, the "Haldy I.," having only the central hinged screw, driven in the same way, is fitted with a similar sized engine using producer gas. The construction of the gas generator is similar to that in use for stationary purposes and has already been described in the Motorwagen, No. 14, 1902. With this generator, the time from first lighting up to starting the engine is only 30 minutes, a full charge of the generator lasting 5 to 6 hours. All danger of explosion is excluded by the partial vacuum in the gas supply pipe. Two other types of boats, fitted with more powerful engines, are described. A detailed description of the regulating arrangements is then given, for which reference must be made to the original paper. The writer is hopeful for the future of this method of propulsion, owing (1) to the small space required, the cargo space being diminished by only 6 to 8 per cent, as against 15 to 20 per cent for a steam engine and boiler; (2) the high thermal efficiency, 24 to 26 per cent compared with 8 to 9 per cent for steam engines; (3) the little attention required, and low working costs which, in the case of the "Haldy I.," work out at 15 to 20 pfennig per barge kilometer, or 0.075 pfennig per (metric) ton kilometer.

The relative consumption of benzine and alcohol at different compressions in a 2-horsepower motor was investigated by W. A. T. Mueller (Zeit. d. Ver. deutsch. Ing.), but the calorific value of the fuels was not tested, and a commercial rather than a scientific result was aimed at. Compressions from 3 to 7½ atmospheres in excess were investigated, the motor being kept

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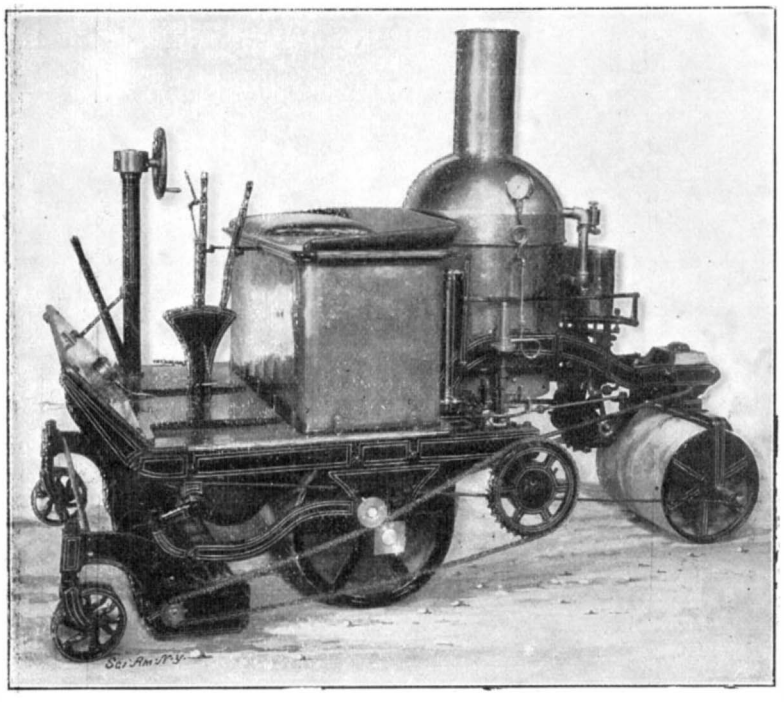
at constant load throughout, and the fuel consumption noted. The general result was that the motor took about twice as much alcohol as benzine—by weight—the alcohol being 90 per cent pure and the benzine having a density between 0.69 and 0.78 according to the sample used. There was a difficulty in starting the motor with pure alcohol, and a tabulated statement of results refers only to mixtures of alcohol with from 5 to 20 per cent of benzine. Calculations of cost are made on the basis of benzine at 25 marks per 100 kilos, and alcohol 90 per cent at 15 marks per 100 liters. The most favorable condition using alcohol appeared to be a high compression (7.5 atmospheres), and in this case the cost per horse power hour was 8.47 pf. for benzine of specific gravity 0.740 and 15.82 pf. for alcohol with 5 per cent benzine. The waste gases from the alcohol were found to contain acetic acid, and the motor did not appear to be cleaner after running on alcohol than after running on benzine.

THE COLDWELL STEAM LAWN MOWER.

The vehicle shown in the accompanying illustration is a self-propelled lawn mower, which has been on the market for the past two years. A number of these machines are now in use. The steam is supplied from a 20-inch boiler of the fire-tube type, which has 24 feet of feed-water heating coils in the dome, and contains 668 fire tubes in its main portion. Directly behind the boiler is a two-cylinder Mason engine of 3⅛ x 4 inch bore and stroke. The engine is connected with a sprocket on the countershaft by means of a heavy chain, and this sprocket can be unlocked from the shaft by throwing out a positive clutch, if it is desired to run the engine alone in order to limber it up, or for any other purpose. The countershaft drives the main roller by a sprocket and chain, and also the lawn mower by means of chains on each side. The roller is



THE COLDWELL STEAM LAWN MOWER.

fitted with two band brakes, one on each side, which are applied by a heel pedal. The machine shown in the illustration is steered by a vertical wheel, but lever steering is also applied to this machine. At the base of the steering post is a wheel, around which is wound a wire rope that extends to the rear roller. The machine is steered by turning this roller. The vertical lever shown in the front is the reversing lever, and the one which is tilted back against the seat is the throttle lever. The machine carries sixty gallons of water and ten gallons of gasoline, the tanks being respectively beneath the seat and the floor board. The water is sufficient to last for an eight-hour run on good ground, while the gasoline consumption for that length of time is about 15 gallons.

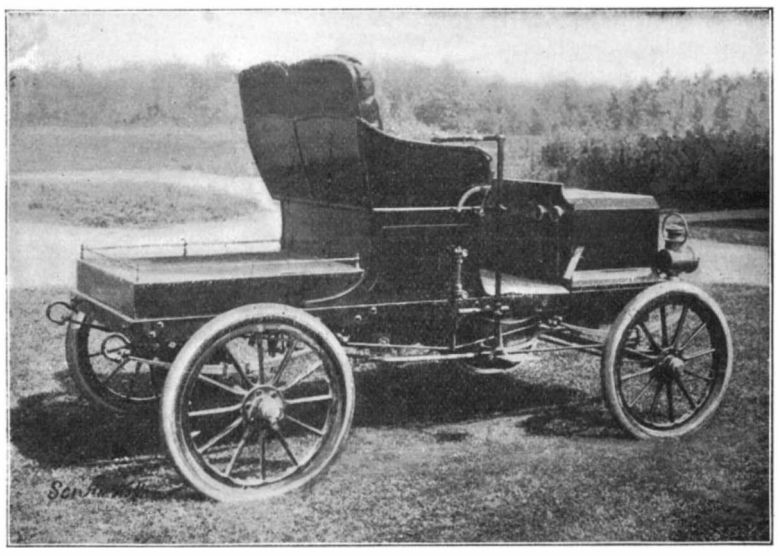
The boiler is fitted with a regular tube burner and fuel regulator, and an automatic air pump for maintaining the pressure in the gasoline tank is geared to the engine. The working pressure employed is 150 pounds per square inch, and the speed of which the machine is capable is four miles per hour. The machine may be used as a roller simply by raising the grass cutter by means of the lever shown at one side. It can be run backward or forward with equal facility. To show what it is capable of doing, it may be mentioned that a 900 x 450-foot polo field can be cut and rolled in eight hours.

The machine may be used for other purposes where power is required, by removing the sprocket from one end of the countershaft and attaching a pulley. Some of the uses to which it has been put are threshing grain, sawing wood, and spraying trees. The boiler can furnish steam to operate a steam water pump, or the machine can drive an ordinary pump with a belt.

A NEW STEAM RUNABOUT.

Grout Brothers, of Orange, Mass., the well-known manufacturers of steam vehicles, have brought out this year a new, low-priced, steam runabout like that shown in our illustration. The engine of this machine is placed horizontally under the rear platform, and can be readily reached for inspection or adjustment by taking up the removable boards of this platform. In this position the engine is directly over the rear axle, which it drives by means of a short chain. The boiler is placed under the seat, and the water tank within the square front bonnet. These are of sufficient capacity to properly supply the 6½-horsepower engine for a reasonable length of time. The chassis of this car is of the reachless type, mounted on 38-inch half-elliptic springs and wood artillery wheels. Wheel steering is fitted if preferred.

The machine is capable of a speed of 15 or 20 miles an hour over ordinary roads, and of climbing 25 to 35 per cent grades. The platform behind makes it useful for touring or for other purposes where the carrying of luggage is required. The Grout Brothers also make a novel touring car with wheel steer and wheel throttle.

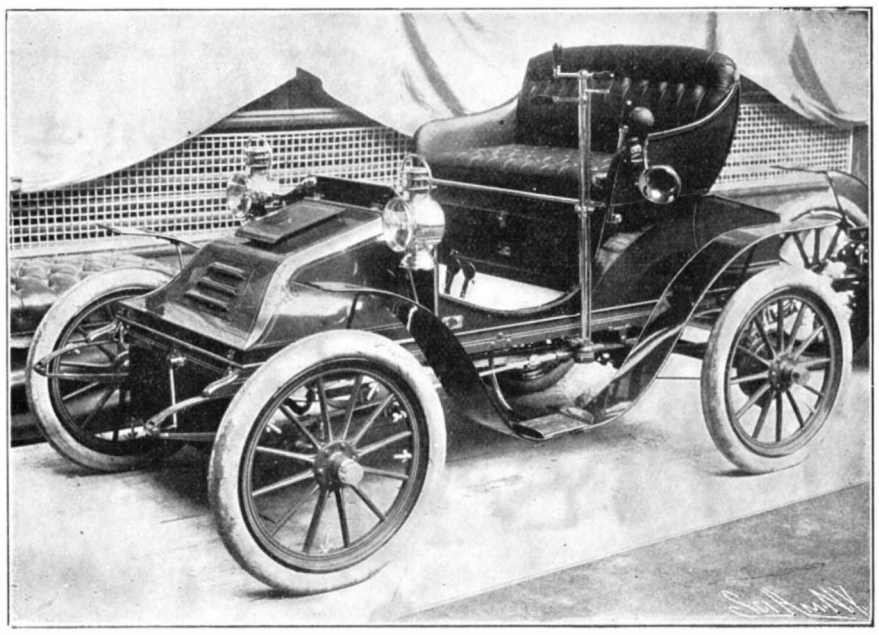


THE GROUT STEAM RUNABOUT.

THE NEW AUTOCAR RUNABOUT.

Our illustration shows a new runabout which has just been brought out by the Autocar Company. The motor is the same as that which has been used in their well-known touring car for the past year, and is a 3¼ x 4 double-cylinder opposed type of engine, geared so that at 1,600 revolutions a minute, it drives the car thirty-five miles an hour. The engine develops ten brake horsepower at 1,000 revolutions a minute. It is fitted with an oiler which is entirely automatic, starting and stopping with the engine. The transmission is of the individual clutch type, giving two speeds forward and a reverse. All of the gears run in oil. The transmission is fitted with ball bearings. The rear axle is driven by a universally-jointed shaft, which transmits power through bevel gears to a short, incased spur-pinion which drives the large gear on the rear axle. The axle is fitted with both ball and Hyatt roller bearings. The steering lever is on the side post, which also carries the spark and reverse handles. A lever beside the seat changes the gears and controls the throttle by twisting the handle. The car is fitted with pressed-steel artillery wheels, and shod with 28 x 3-inch tires. The gasoline capacity is eight gallons, which is sufficient for a 200-mile run. The weight of the car complete is about 1,175 pounds. It has a 70-inch wheel base and a 52-inch tread.

The regular autocar is being built this year with several improvements. A small wheel steering device is used in place of the lever arrangement employed on the runabout, and ball bearings of special design find a place in the transmission. All controlling handles are arranged on the steering-post, and the change-gear-lever is disposed directly under the steering-wheel rim, so that it may be operated by the right hand. The clutch-shifting lever is operated by the left hand, and is also arranged below the steering wheel, while the turning of its handle controls the throttle. The ignition-lever is placed conveniently to the left hand. An arrangement is provided, so that when the clutch is thrown in, the speed of the engine is automatically accelerated. The engine may also be throttled by a simple twist of the wrist. When the emergency brake is applied, the clutch is thrown out. The 4 x 4 engine used in this car develops eleven brake horse power at 1,000 revolutions.



THE AUTO-CAR DOUBLE OPPOSED-CYLINDER RUNABOUT.

A Simple Combined Weather Vane and Anemometer.

The ordinary weather vane indicates the direction of the wind, but gives no information about its intensity or velocity. A German inventor, Franz Spengler, has remedied this defect very simply by hanging from a sleeve which turns with the vane, a metal plate whose inclination to the vertical indicates the force of the wind. The plate travels over a graduated quadrant of which the part above, or to leeward, of the plate is closed by overlapping sectors pivoted at the center of the arc, while the lower or windward part is kept open by the lifting of the sectors by the wind plate itself. The contrast of light and shade so produced facilitates the reading of the instrument from a distance. The quadrant is graduated on the international scale, velocities of 5, 10, 15, 20, and 25 meters per second being indicated by projecting points, and, presumably, it is graduated empirically by comparison with a standard anemometer. The instrument is intended, of course, only for rough measurements.

A Test of the Lake Submarine.

A board of army officers, consisting of Major A. Murray, Capt. Parker, and Capt. Bailey, from Fort Totten, New York, were in Newport on January 19 to make an inspection and test of the Lake submarine torpedo boat "Protector," with a view to finding out her usefulness as an adjunct to military coast and harbor defense and also in mine defense.

The "Protector" was taken out into the bay and sunk to the bottom near the telephone cable which crosses the bay. With Major Murray in the diving room the cable was picked up and the motions of cutting it gone through. The boat was then run submerged thirty feet below the surface, during which the signal mast was carried away by ice.

Dinner was cooked and served to the members of the board while the vessel rested on the bottom. The temperature was about zero, yet it was not uncomfortable on board the "Protector."

Airship Competition.

United States Consul J. C. McNally writes from Liege, Belgium, under date of November 27, 1903, to say that the authorities of the universal exposition, to be held in Liege in 1905, have decided to offer a prize of $19,300 for an airship competition to be held in connection therewith. The details of the contest are now under consideration.

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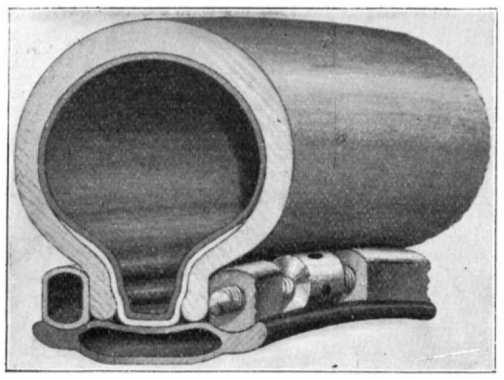
A NEW DETACHABLE TIRE.

Despite years of experience with bicycle tires and the large number of automobile tires invented, every year seems to bring still further improvements on this vital part of the automobile. The accompanying engraving shows one of the latest types of automobile tires, which has been brought out by the Hartford Rubber Works. This construction provides a simple means for removing the tire quickly and conveniently from the wheel. The wheel rim, it will be observed, is



IMPROVED DETACHABLE TIRE.

flat in cross section, with two grooves formed near the edges on the outer surface, to receive the retaining rings. The retaining rings are formed of metal tubing bent around the wheel rim, and closed at their ends by plugs firmly secured therein. These ends are tightly drawn together by a double-ended bolt with right and left-hand threads, which screws into the plugs, thus firmly holding the retaining ring in place. The tire, as shown, is held between the two retaining rings. When it is desired to remove the tire, it is only necessary to remove one of the rings, and this can be done by giving the bolt a few turns, which loosens the ring to such an extent that it can be removed from the rim, permitting the tire to be slipped off.

THE CADILLAC PLANETARY GEAR TRANSMISSION.

The transmission gear used on the Cadillac car may be taken as typical of all the planetary gear transmissions used at the present time. It consists, as will be seen from the annexed cut, of two drums, *H* and *K*, the former of which contains six studs, *L*, having mounted on them six spur pinions. Three of these pinions, *E*, are twice the width of the other three, *F*, and all mesh with a pinion the width of the *F* pinions and placed at *G* in the diagram, although it is not shown. This pinion is on a sleeve keyed to the hub of the drum, *K*. The main driving pinion, *D*, is keyed to the driving shaft, and meshes with the *E* pinions only, on the widened portion which projects beyond the pinions, *F*, as shown in the cut. The left end of the gear case, *C*, is fastened to *H* by screws. The drum, *B*, on which is the internal gear, is continued through the casing, and the sprocket, *A*, forms part of it. The operation of the transmission, the driving shaft of which is direct-connected to the crank shaft of the motor, is as follows: The brake drum, *H*, with the pinion studs upon it, is held stationary by a band brake; and when pinion, *D*, turns with the shaft in the direction of the arrow upon it, it drives pinion, *E*, in the direction shown by its arrow, and, since *E*'s stud is stationary, *E* in turn drives internal gear, *B*, in the opposite direction. This produces the reverse. To obtain the slow speed, the brake drum, *K*, is held by a brake band, and pinion, *D*, drives pinions, *E*, as heretofore. *E* in turn drives *F*, but as *G* is stationary, since it forms part of the drum, *K*, the pinions, *F*, travel round it with a planetary motion, thus turning the drum, *H*, slowly and causing the pinions, *E*, to turn the internal gear and drum, *B*, even more slowly, but in the same direction as that in which *D* is turning. For the high speed, a leather-faced disk keyed to the shaft is pushed against the smooth surface on the right-hand end of drum, *K*, thus locking *K* to the shaft, and causing the whole drum to turn as one unit without any of the gears revolving. When the car is standing still and the engine is running, all the gears are turning, and the drum is revolving idly about the shaft. Another form of planetary gear transmission that is now widely used has no internal gears whatever, but the form illustrated is a simple one, in that the internal gears are reduced to but one, which is used only for the reverse.

A COMBINATION TOOL FOR AUTOMOBILES.

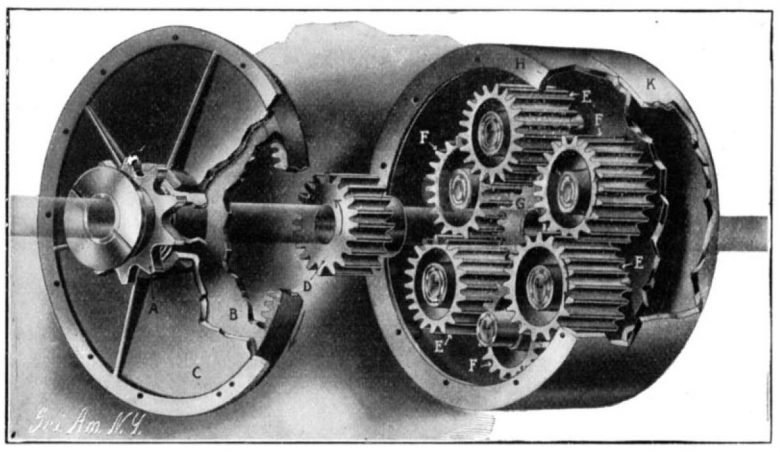
BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

A novel combination tool for automobilists has been devised by Mr. F. V. Dalton, of England, the feature of which is that therein are incorporated many of the tools which are often required on the road when a breakdown occurs, but are not carried on board, owing to their bulky nature. In this device, however, these tools have been ingeniously compressed. The new tool can be operated as a lifting jack; a handy, albeit powerful, vise; and a drilling machine. When dismembered and packed away, it requires no more space than is generally occupied by the ordinary lifting jack.

The device consists essentially of but seven pieces, which are shown disconnected in the first illustration. The letter *A* represents the largest portion of the tool, a malleable casting with its extremities comprising jaws, as in the ordinary vise. This portion is made in three pieces, the jaw pieces being hinged on either side of the central casting by means of detachable pins. The faces of the jaws are roughened in the conventional manner to insure a firm grip when the tool is used as a vise. It is equally serviceable for small parts, such as bolts, nuts, screws, and pipes.

Between the two jaw arms is hinged a link comprising the central casting, which is machined out to carry the small sleeve, *E*, which is held firmly in position when inserted by means of the setscrew, *a*. Through each jaw arm is another hole. When these arms are hinged over so as to form a vise, these holes are brought into the same horizontal plane, and through these works the feed-screw, *B*, which constitutes one of the vital parts of the whole tool, and in this particular instance serves to open and close the vise.

The feed-screw, *B*, is of the same gage as the thread in the piece, *E*, in which it works. It is made of steel and is hollow. Through this feed-screw extends a steel spindle, held in position to prevent any longitudinal movement, by a ball thrust bearing at the upper end and a collar at the lower extremity. The upper end of this spindle terminates in a broad block with a concave face, as in an ordinary lifting jack. In the center of this head is a square-cut hole to carry a drill. Just behind this head is the ball bearing, and then comes the casting, *b*, which is free, so as to turn



CADILLAC PLANETARY GEAR TRANSMISSION.

in either direction upon the feed-screw. This casting is fitted with a double pawl, which is so pivoted that it can be made to engage either to the right or left in the slots in the head, *e*, on the feed-screw, acting ratchet fashion, so that the feed-screw can be made to turn right or left as desired. The opposite end of the spindle in the feed-screw is squared.

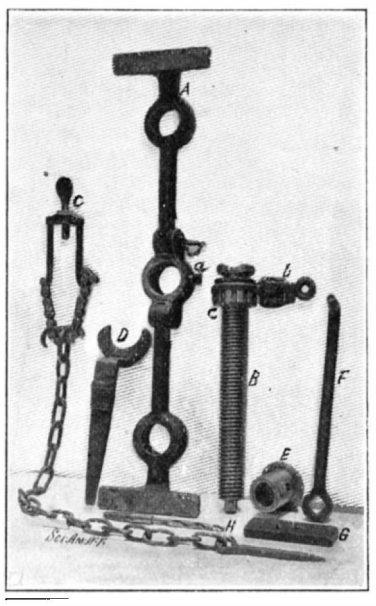
F is a forging bent at one end, flattened at the other end, and pierced with a square hole, to fit like a spanner upon the square end of the spindle in the feed-screw, *B*. The bend in the upper end forms a right angle, and has a reduced cut around it. This extremity is inserted in a hole in the small casting, *b*, forming a handle to operate the feed-screw, *B*. On the feed-screw is fixed a small spring projecting slightly over a hole parallel with the axis of the screw, and which engages on a narrow saw-cut around an inserted movable ratchet pawl, thus keeping the pawl in its proper working position. This spanner also fits the head of the setscrew, *a*, in the center casting of the piece, *A*.

C is a clamp fitted with a thumbscrew and two projecting pins, one on either side, with hooks attached. One of these hooks is made to engage in one end of a block chain, and the other hook is so fashioned that it will take any link in the chain, so that the latter may be shortened or lengthened as the exigency of the work in hand demands. Another chain of ordinary links is attached to the block chain by the fastening shown in the illustration, which enables an even or balanced purchase to be obtained. The other end of this second chain is provided with a pin which will pass through any link of the chain.

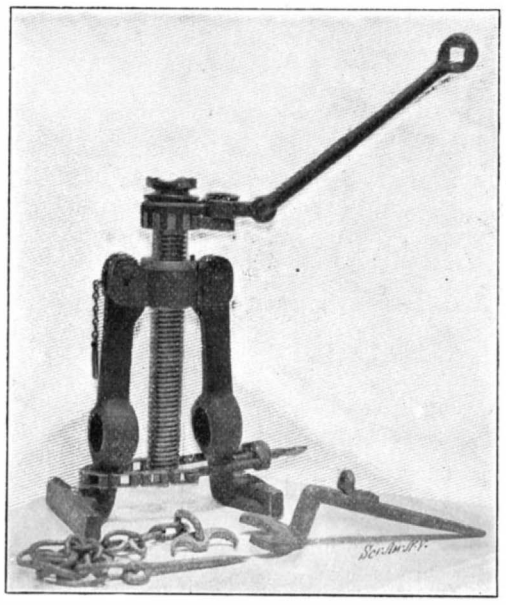
The remaining two pieces, *D* and *G*, are of minor character. The forging, *D*, is somewhat similar in shape to a spanner. The larger end encircles the feed-screw, *B*, while the other end has a blunt point. *G* is simply a bar of iron which can be used for any purpose that may arise, such as the bedplate in the drill, and is consequently not a necessary part of the outfit. *H* is the drill.

This tool can be accommodated to any of the functions which it is intended to fulfill with ease and celerity, and the accompanying photographs will show how it is accommodated to these respective operations. For use as a lifting jack the vise-jaw arms are bent over with the jaws outside, the sleeve, *E*, is inserted in the central hole of *A*, a shoulder on the sleeve preventing it passing right through. The vise jaws are converted into feet for the jack, giving it thereby a solid foundation, and are prevented from springing open by the clamp and block chain, *C*. The feed screw, *B*, is threaded into the sleeve, and the handle, *F*, attached as shown. This jack is both powerful and strong, and is sufficient to cope with any lifting operation that may arise with the general type of automobile, its maximum lifting capacity being two tons.

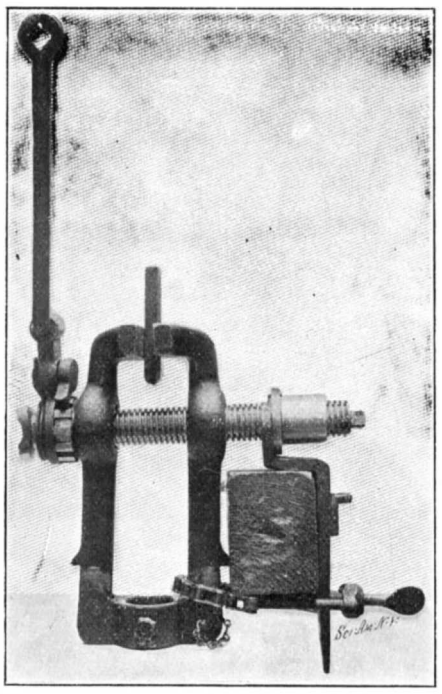
To employ the tool as a drill. the arrangement is slightly modified from that required for the jack, as may be seen by reference to the illustration. In this instance the feed-screw is reversed. and in



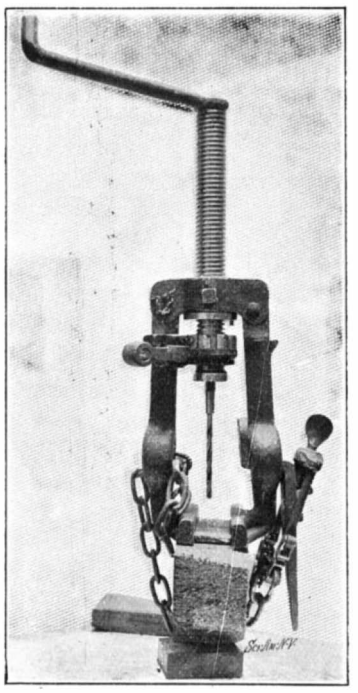
Component Parts of the Tool.



The Tool as a Lifting Jack.



How the Tool Forms a Vice.



The Tool Arranged as a Drill.

AN AUTOMOBILE TOOL THAT CAN BE USED IN SEVERAL WAYS.

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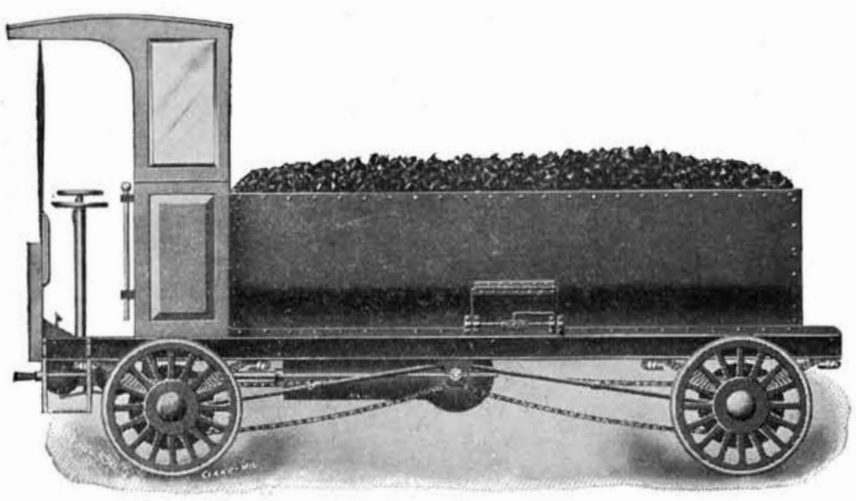
Applies power from one engine or motor to all wheels. Busses and Freight and Delivery Wagons, one to ten ton capacity, any kind of power desired



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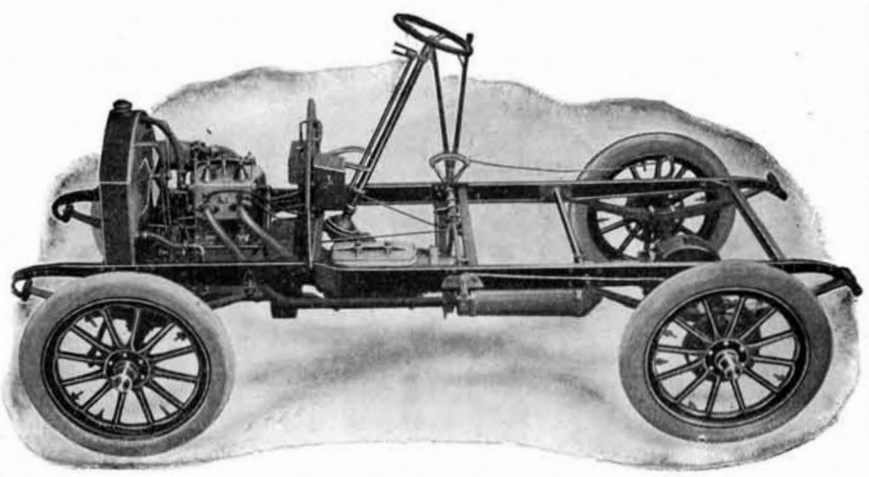
A Practical Motor Car with an Intrinsic Value

The Royal Tourist



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16 horse power, two cylinders, 1,800 pounds, **$2,300**
32 horse power, four cylinders, 2,000 pounds, **$3,000**
Aluminium Bodies, Complete Equipments

The Royal Motor Car Co.

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Cleveland, Ohio

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the square hole provided in the lower end, the drill is inserted. The feed is controlled by slowly turning the screw by hand, or by tightening the setscrew, *a*, and operating the ratchet. The ball bearing on the end of this feed-screw takes all the thrust of the drill against the feed-screw, and the shoulder on the sleeve, *E*, which is also reversed for this operation, takes up the thrust against the casting, *A*. The drill can be adapted for hand, or it can be attached to an object, such as the bar of a gate. In the former case, the object to be drilled can be tightly held in position between the jaws of the vise. For the alternative method, the drill is attached to the object in the manner shown in the illustration.

To convert the tool into a vise, the arms of the casting, *A*, are bent inward. The feed-screw is inserted horizontally through the hole in either end of the arms, and the sleeve, *E*, is brought to bear upon *D*, thus obtaining the necessary action for tightening or releasing the vise. In this operation, also, it is necessary to attach the vise for rigidity upon another object.

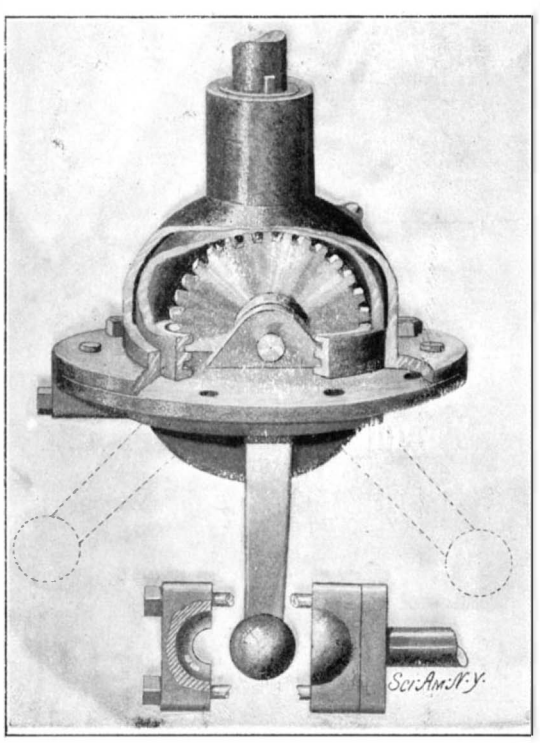
This combination tool is strongly constructed, so that it may withstand considerable hard wear and tear. Yet weight has been reduced as much as practicable, so as not to render it unwieldy. Furthermore, when the parts are detached, they can be packed up into such small compass as to occupy but very little space, and, owing to the number of component parts, the tool can be adapted to either of its purposes with celerity and facility. Its total weight is but 11 pounds and its height 11 inches.

THE BROWN-LIPE STEERING DEVICE.

A wheel steering device which was brought out a year ago by the Brown-Lipe Gear Company, Syracuse, N. Y., is of quite novel construction, and is found on many of the 1904 machines. This steering device was invented by Alexander T. Brown, and it has for its object the providing of an irreversible steering arrangement that can be readily attached to any style of vehicle. The novel feature of the device consists of an internal worm cut on the inner surface of a cup which is attached to the steering post. The internal worm meshes with a gear wheel, on the shaft of which is the steering arm that is connected to the steering lever of the front wheels.

The operation of the device can be seen almost at a glance. The cup containing the worm gear is filled with oil, and consequently has but very little wear. One and a half turns of the steering wheel operate the lever its full throw of 90 deg. The device is self-locking and irreversible, so that it is impossible for the front wheels to change their course if they run against an obstruction in the road.

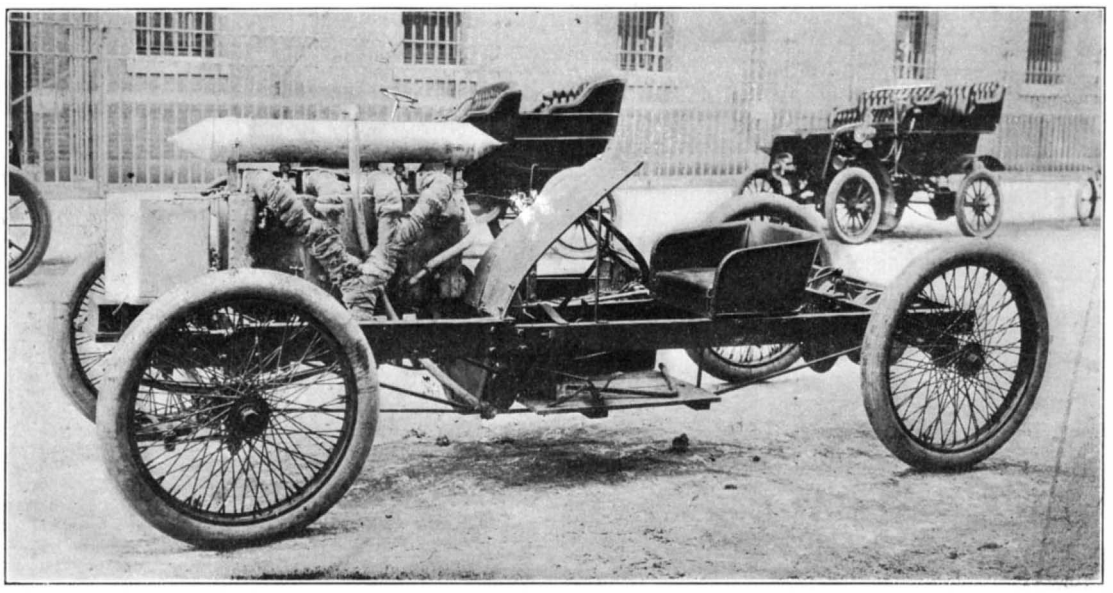
A model of the Assouan Dam, which is on the first cataract of the Nile, will be exhibited in Great Britain's display at the World's Fair. The model is 16 by 4 feet and is the property of Sir Benjamin Baker, the engineer of the dam.



AN INTERNAL-WORM STEERING DEVICE.

THE FORD RECORD-BREAKING RACER.

The racer on which Henry Ford made a world's record on the ice of a mile in 39 2-5 seconds is shown in one of our illustrations. Its appearance is much the same as when it made its first records about one year ago. The change from lever to wheel steering, with a curved wind shield in front of the driver's seat; the substitution of a cylindrical water tank placed on top of the motor, and directly connected to its water jacket, for the old water tank and radiating coils; and the placing of a gasoline tank in front of the motor, are the principal changes. The inlet pipes are shown covered with burlap to prevent too great condensation. A full description of the entire machine was given in our issue of January 17, 1903. It will suffice to state that the motor has four cylinders of 7-inch bore and stroke, and that at the speed of 90 miles an hour, which the car made on the ice, it turns at the rate of 860 revolutions per minute.



FORD RACER WITH RECORD OF A MILE IN 39⅖ SECONDS.

The record was made on the ice of Lake St. Clair, Michigan, on January 12. A mile and a half start was used, in which to get up speed. Edward Huff, Ford's assistant, crouched on the frame in front of the wind shield and held open the carbureter throttle, simply because the jarring due to rough places rendered it impossible to hold the throttle open with the regular pedal. The machine slewed more or less to each side of the 15-foot track, and it ran five-eighths of a mile through the snow after the spark had been cut off. Mr. Ford wore no goggles, and he states that the rush of air was so terrific he could barely see the course, as he was obliged to keep his eyes almost closed.

GLASS-FRONT PROTECTOR FOR PHAETONS.

Although many of the large touring cars this year are fitted with canopy tops and glass fronts, but few runabouts were shown so equipped at the Automobile Show. One of the simplest of these equipments was that on the Elmore runabout, which, it is claimed, can easily be adapted to any phaeton or buggy with a top. The front is contained in a frame which is clamped to the carriage top and to the dash by means of several thumb screws. Side curtains can be buckled to the top, thus completely inclosing the occupants of the carriage. The glass front has a window, which can be raised if the weather permits. This simple attachment should be of great service to physicians and all others who are obliged to drive an automobile in stormy weather.

Dr. Morton's Theory of the Therapeutic Value of Radium Solutions.

Radium and actinium were discussed recently before the Technology Club of New York in the operating rooms of Dr. William J. Morton, by Dr. George F. Kunz and Dr. Morton, who is professor of electrotherapeutics in the New York Post Graduate Medical School and Hospital.

Dr. Morton explained in detail the uses to which radium might be put in curing diseases, particularly those of an internal nature.

"Medicine," he said, "is gradually abandoning its old-fashioned concoctions, and we are taking up radium with exceedingly bright prospects. Its use will consist of physical treatment almost exclusively. The Roentgen ray has been of immense value in curing cancer, but radium promises to go far ahead of it. If we had radium of 150,000 activity we could no doubt do a great deal more than we are doing now. Most of us have been confined to a much lower radioactivity. We have been working with from 7,000 to 10,000 luminosity.

"The actual glow of radium does not represent its actual radioactivity. There is a great difference in the ore. One sort of radium may possess a high luminosity, while another sort may have a high radioactivity and very little luminosity. We cannot boast of the luminosity of the kind which we now have."

Dr. Morton startled his hearers by telling of a mixture which he had prepared and called "liquid sunshine," the name having been applied because the doctor regarded it as a good "catch" phrase to give to the preparation. By means of this fluid, he said, the whole interior of a patient could be lighted up.

The doctor exhibited six tubes containing "liquid sunshine," one of which, he explained, contained quinine sulphate which had been exposed to radioactivity. He then proceeded to show the luminous quality of the fluid by placing each tube before a strong X-ray, whereupon a spot of faint light was seen about the size of the palm of the human hand.

"That," said the doctor, "would be the result if the liquid were taken inside. I believe," he added, "that radium may after all be the real curative property which has been found in so many spring waters throughout the world.

"The advantage of radium over the X-ray is that it can be applied directly to the part affected. For example, if placed in a small tube it may be inserted in the throat, and in similar manner it may be applied to any vital region. In other words, with radium we shall be able to get at the seat of diseases. There is no end, in my opinion, to the cures which may be effected by radioactivity, excited in one way or another.

"In imparting radioactivity to liquids, however, we will have to be extremely careful, and physicians will need to use the utmost discretion in advising patients to drink the fluid. It will be possible, however, to bathe a patient's entire interior in violet or ultra-violet light as the result of this discovery, and this light we have decided to call 'sunshine.' We know of the value of sunshine on the outside, particularly where bald heads are concerned, and we believe it will have a similar effect on the inside."

Mr. Morton told of several cures of cancer by radium, and exhibited a bell-shaped glass, where the smaller tubes of radium, of about 7,000 activity, could be placed in the flesh affected. As the activities of radium became greater, he expected that more important results would follow.

A brake shoe is being constructed by an American firm having a hard iron insert around which is cast the body of the shoe in gray iron. The gray iron is not permitted to chill, which is claimed to be a peculiarity of this shoe as compared to others of the kind. The hard iron is made of very high-grade malleable iron. The secret processes of casting gray iron about the insert without chilling are said to give toughness to the body of the shoe, and a better friction coefficient than a chilled shoe.

GLASS FRONT AND SIDE CURTAINS AS APPLIED TO A RUNABOUT.

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The Car that Climbs

That the Cadillac has greater structural strength and more power per pound of weight than any other moderate-priced motor-car in America was demonstrated when one of our stock runabouts successfully ascended the steps of the National Capitol. This is proven anew by the test shown in the photograph above—a performance few $2500 machines could duplicate.

An automobile that can carry loads and negotiate grades not met with in practice will never be found wanting in any of the ordinary—or extraordinary—exigencies of motor travel. The Cadillac leads its class in tractive effort and carrying capacity; and for speed, simplicity, durability, grace of design and perfection of appointments is not surpassed by any automobile costing twice as much.

These are the reasons why motor-car excellence for the man of moderate means is summed up in the word

CADILLAC

Note these features—unique with the Cadillac or found only in high-priced cars:

High and low gears independently accessible—no chance to "work wrong combinations" or damage the transmission by changing speed too quickly.

Emergency brake acting on side gears of differential—*not on driving sprocket*—a feature which avoids at once the unsightliness of brake drums on the wheels, and the unreliability of the ordinary differential brake.

Cylinder cast separate and bolted to frame; improved water jacket—no gaskets to burn or blow out; mechanically operated valves; direct drive on high gear; absolute control—throttle and spark. Positive and sensitive wheel steering gear.

The Cadillac will take any ordinary grade on the high gear; will make 30 miles an hour on good roads; will go anywhere a wheel-hold can be obtained.

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Write for free illustrated booklet N, which gives address of agency nearest you where the Cadillac may be seen and tried.

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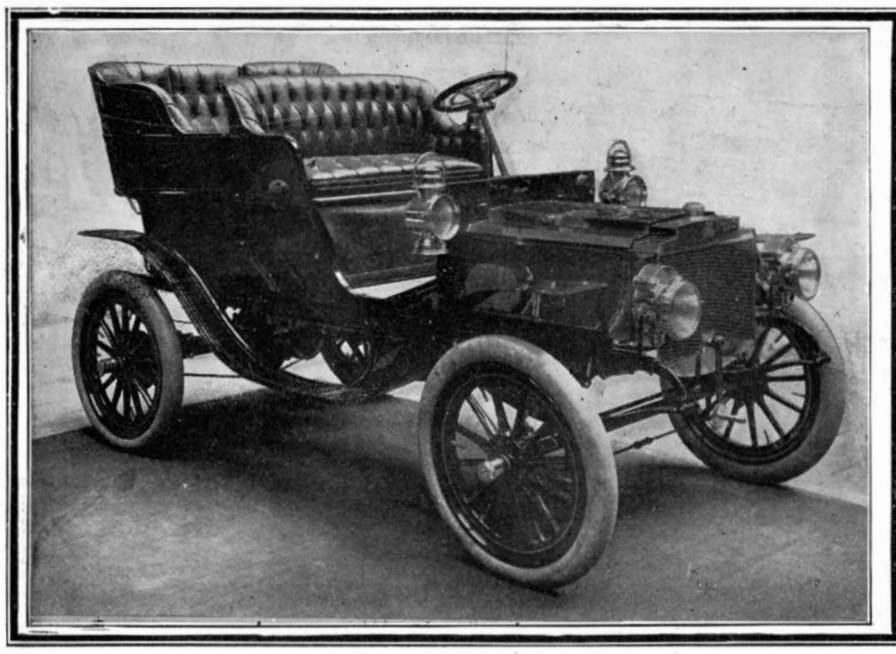
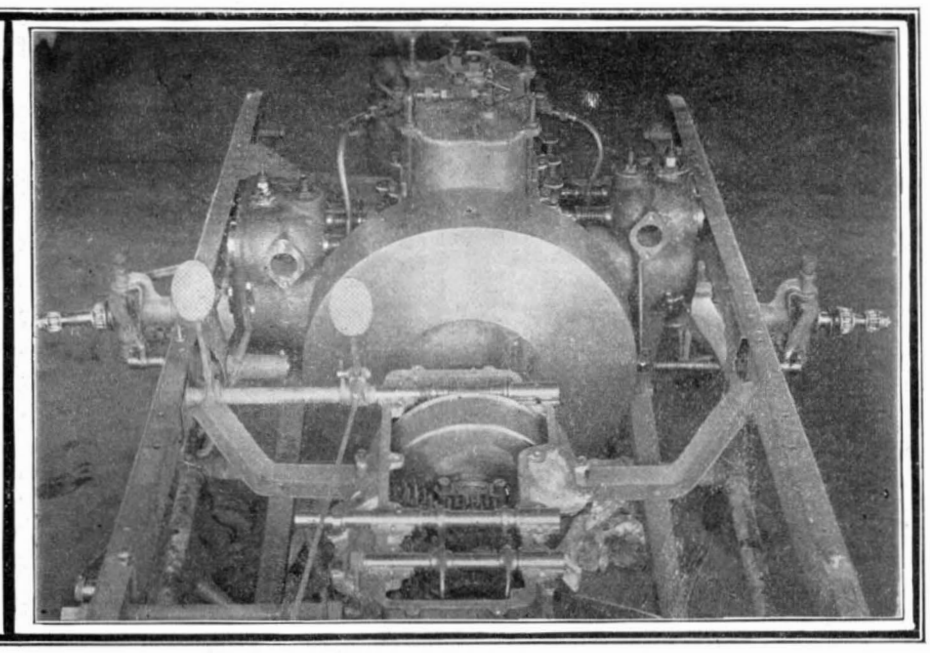
THE NEW COLUMBIA TOURING CAR.

Our illustrations show the general appearance and part of the chassis of the new Columbia double opposed-cylinder touring car, which was designed by Mr. H. P. Maxim, and the first model of which was on exhibition at the Automobile Show. The 4¼ x 5, double, opposed-cylinder motor is placed crosswise of the frame, under the bonnet. This motor runs at 1,000 revolutions per minute at a speed of 25 miles an hour of the car, and is said to develop from 12 to 14 horse power. The oil tank on top of the crank case contains two sight-feed chambers, through which there is a pressure feed to each cylinder, the pressure of the compression in the case being used to feed the oil. The carbureter is of special design, the auxiliary air passage being located beside the main air passage containing the spraying nozzle. The former has a throttle located near its outer end, while the main throttle is in the pipe to which both of these passages are connected. The motor is provided with a ball governor, which operates on the throttle, and the auxiliary air throttle is suitably connected with the main throttle, so that a perfect mixture is maintained at all speeds. The transmission gear is of the sliding type, and contains two sliding sets of gears, which are operated by two separate levers. An expanding ring clutch in the forward end of the transmission gear case, which can be readily seen in the photograph, differentiates this machine from most others of the type. This clutch is released by a pedal, and is also automatically released before the brake can be applied. The regular service brake is of the expanding ring type, on a bevel gear stub shaft next to the differential casing. The emergency brakes are on the rear wheels, and are operated by a lever. A wheel steering device with a rack and pinion is employed, and the wheel can be turned without moving the sectors on which are contained the sparking and throttle levers. A live rear axle with bevel gear drive is employed, and runs on roller bearings. The gasoline tank is filled from the outside of the carriage through a funnel-shaped opening seen beside the front seat. By opening a door in the side of the carriage, the driver can determine the level of gasoline in the tank by means of three pet cocks arranged at different heights in its end. Below the tank there is a tool drawer, which can be readily pulled out and used whenever desired.



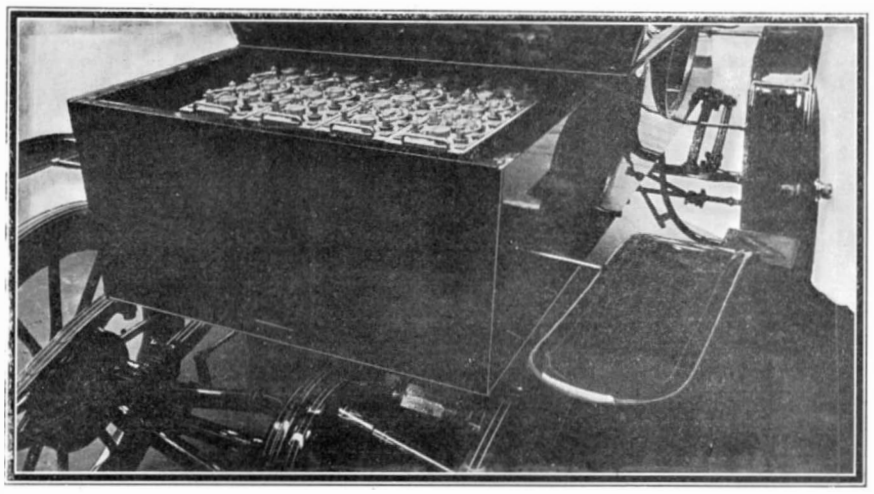
THE COLUMBIA 12-HORSEPOWER TOURING CAR.



FRONT END OF CHASSIS OF COLUMBIA CAR.

THE WAVERLEY ELECTRIC RUNABOUT WITH EDISON BATTERY.

The illustration shows the appearance of a set of thirty-two 160-ampere-hour cells of Edison battery in the specially-constructed battery box of a Waverley runabout. The cells are higher than the lead battery cells generally used, thus necessitating the use of an extra deep box. The steel jars are arranged eight in a crate. They furnish an average electromotive force of 1.25 volts at a 30-ampere discharge rate, which is that required to run the machine at 15 miles an hour. The runabout is fitted with three speeds ahead and two reverse. It has a radius on one charge of 40 miles, the main feature emphasized being the durability of the battery and not its high capacity. Each hermetically-sealed cell is fitted with a hinged cap which springs open when the catch is released. The only attention these cells require is the addition of pure water about once a week.



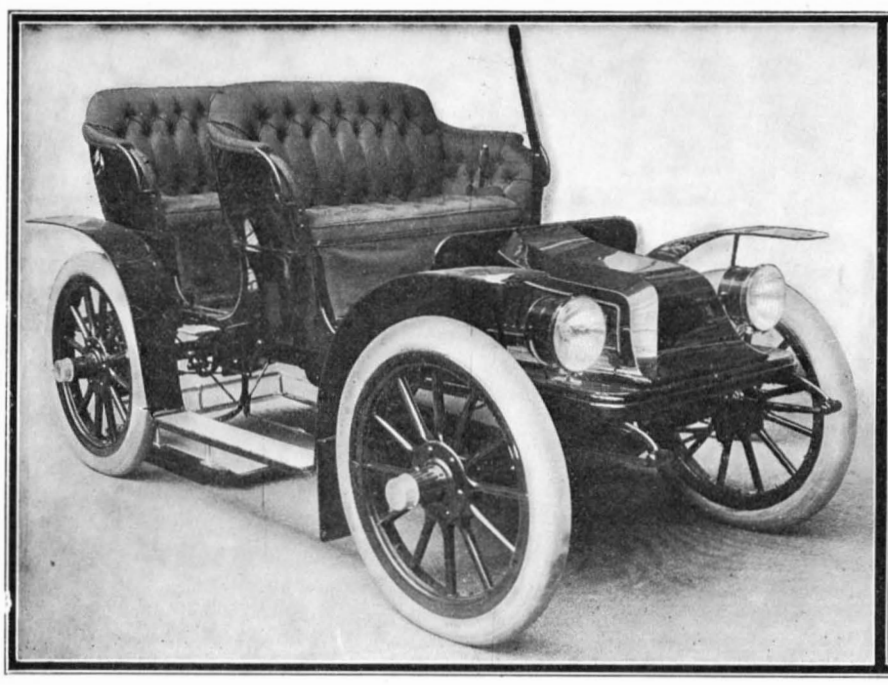
AN EDISON BATTERY IN A WAVERLEY RUNABOUT.

A GASOLINE HANSOM CAB.

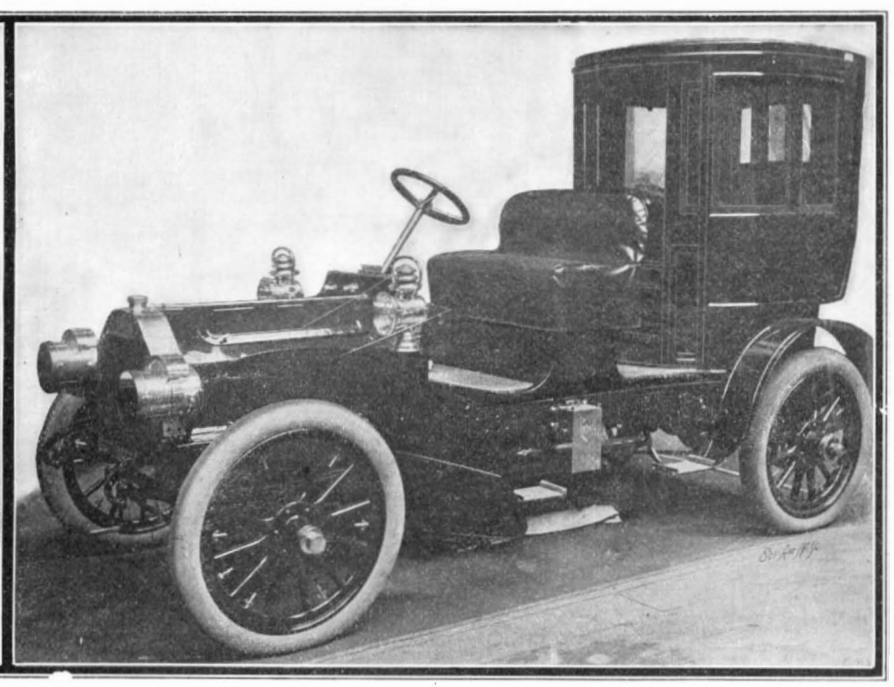
The hansom cab shown in our illustration is on distinctly novel lines, and is patterned somewhat after a machine that was designed for use in London streets, but which, we understand, never materialized in very large numbers. This luxurious vehicle was built by the Peerless Motor Car Company, particularly for city use. It has a very long wheel base, and the cab is situated at the rear end of the chassis, which is hung on easy-riding springs. The cab is luxuriously upholstered, fitted with curved sliding doors, and has a small electric light in the ceiling. The driver's seat is in front, and is sufficiently wide to accommodate one or two extra people. The machine is fitted with a Peerless 24-horsepower motor, shown on page 78. It has a standard Peerless equipment, similar to the touring car already described.

A NEW LIGHT-WEIGHT ELECTRIC SURREY.

The Baker electric surrey depicted below is of distinctly novel construction, in that the electric motor is placed forward under the bonnet, the same as on any ordinary gasoline touring car. The shaft of the motor runs longitudinally of the carriage, and a pinion on its rear end drives a large gear on the forward end of the main driving shaft, which extends to the rear axle and drives it by bevel gears. Ball bearings are used throughout the machine, which is of comparatively light weight—about 1,700 pounds. Twenty-four cells of lead storage battery furnish the current to drive the machine. The 48-volt motor is thoroughly protected from water and dust by means of a rubber apron beneath it. It has a total radius of 40 miles on a charge. This new arrangement of the motor on an electric vehicle, while perhaps not so efficient as the usual rear wheel drive, is certainly much more conducive to the long life of the motor, besides increasing the facility with which it may be inspected.



AN ELECTRIC SURREY WITH MOTOR UNDER FRONT BONNET.



A GASOLINE HANSOM CAB.

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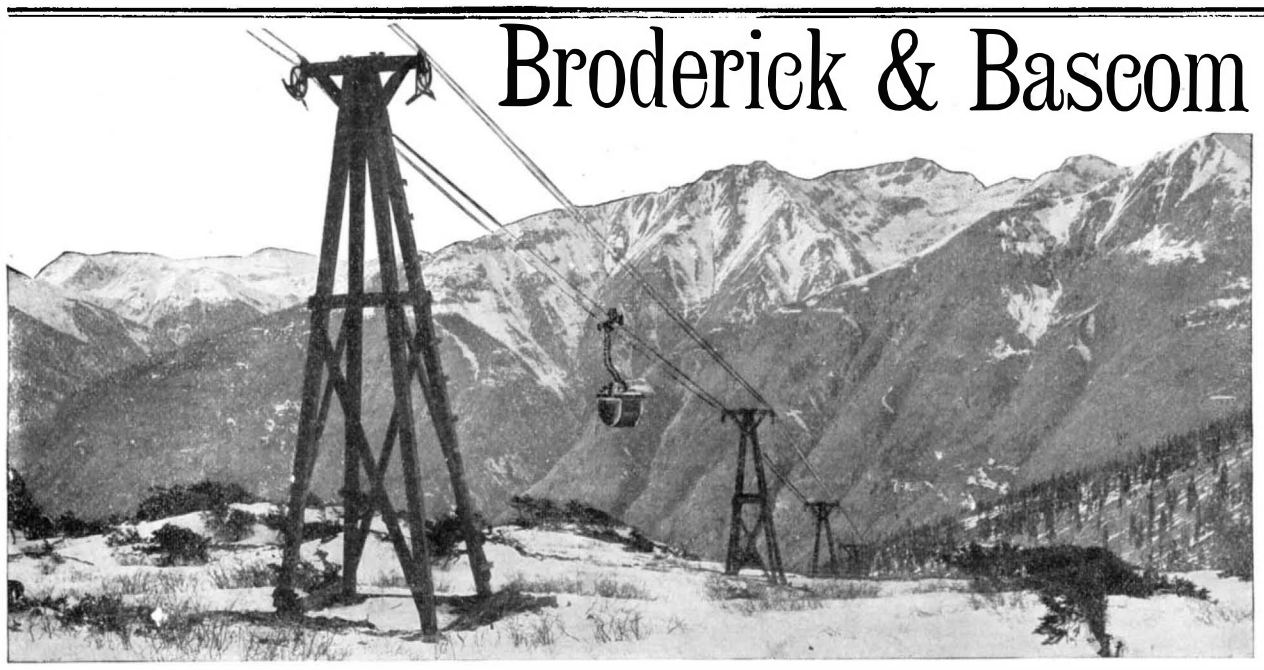

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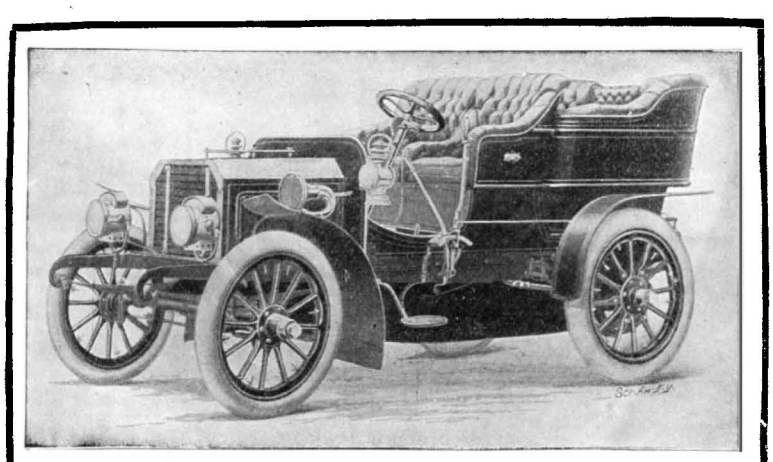

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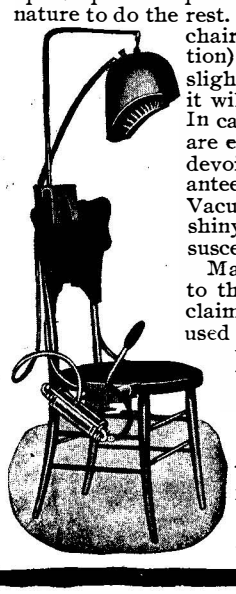
Stimulation without irritation is the only logical method of restoring the natural supply of blood to the scalp, thus reinvigorating the dormant follicle, preventing the hair from falling, and inducing a normal growth of hair. This treatment may properly be termed **Physical Culture for the Scalp,** and it can be obtained only with THE EVANS VACUUM CAP, which, during the past three years, has been used with invariable success in this and foreign countries.

The Evans Vacuum Cap

is a mechanical appliance which produces a natural circulation in the scalp, opens up the temporal arteries, brings about normal conditions and enables nature to do the rest. It is simple in construction, can be attached to any chair in a moment (as seen by the accompanying illustration) and is easily adjusted to the head, without causing the slightest discomfort. If used for a few minutes each day it will produce satisfactory results in four to six weeks. In cases of complete baldness, however, when the follicles are entirely dead, and the scalp becomes shiny and utterly devoid of hair, THE EVANS VACUUM CAP is not guaranteed to produce results. Even in such cases, the Evans Vacuum Treatment will loosen the scalp, eliminate the shiny appearance and make the unprotected scalp less susceptible to currents of air and draughts.



Many eminent physicians testify from actual experience to the merit of the Evans Vacuum Treatment, and the claims made for it are substantiated by hundreds who have used it. Let us send you our free illustrated booklet, which fully explains the treatment. We want to prove to you that at last a cure for baldness is found.

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A TWIN-BALLOON AIRSHIP.

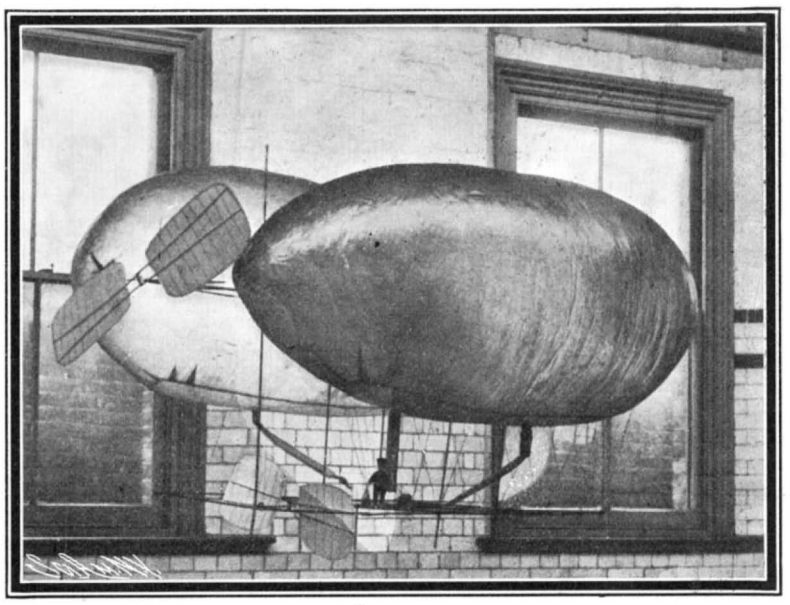
BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

A new type of dirigible balloon is in course of construction in London, which is the invention of Mr. L. J. Andersen. The principal feature of this latest aerostat is that two balloons, placed side by side, of identical shape and capacity, are employed to lift the vessel. It is maintained by the inventor that by this system of twin balloons it is possible when flying to maintain a straighter and more even course, while greater facilities in regard to the steering are available than by the employment of only one gas bag.

Already the inventor has constructed a model, to scale, of his ultimate airship for the purpose of experiments. In this model the balloons are each 7 feet in length. So successful were the experiments, that the inventor is now constructing a full-sized vessel. The balloons are elliptical in shape, and will measure 70 feet in length by 27 feet diameter at the widest part. They will each be of approximately 27,000 feet of hydrogen gas, thus giving them a lifting power of 4,000 pounds.

The framework, or deck, of the vessel will measure 75 feet in length, and is to be constructed of bamboo. Another feature of the craft will be the employment of three propellers. The main propeller will be placed at the stern, together with the rudder. By an ingenious arrangement, however, the pitch of this driving propeller may be varied from the deck of the vessel as desired, the object of which is to use it as an auxiliary though powerful rudder, for maintaining or altering the ship's course according to the exigencies that arise. The two subsidiary propellers are placed at the bow and stern of the deck respectively, and are intended to supplement the driving power of the mechanism. The whole of the machinery is placed between the two balloons; for the inventor holds that by this design the improvement of the steering possibilities and the maintenance of a straight course are materially increased. The motion of the propellers and their design are entirely new, coinciding as nearly as possible to a reciprocatory motion, so that the nearest approach to the motion of a bird's wing is obtained. The propellers are to measure 30 feet in diameter.

The motive power is to be supplied from a 50-horsepower electric motor, and the inventor anticipates that a speed varying from 14 to 20 miles an hour in fair weather will be attained. The total weight of the vessel will be 3,000 pounds, which leaves a balance of 1,000 pounds, after deducting this weight from the lifting capacity of the aerostat, for the carriage of passengers, ballast, etc. It is hoped that the balloon will be ready for trials some time this year, and its total cost will approximate $10,000.



A CATAMARAN AIRSHIP.

THE WINDOWS OF THE SEA.

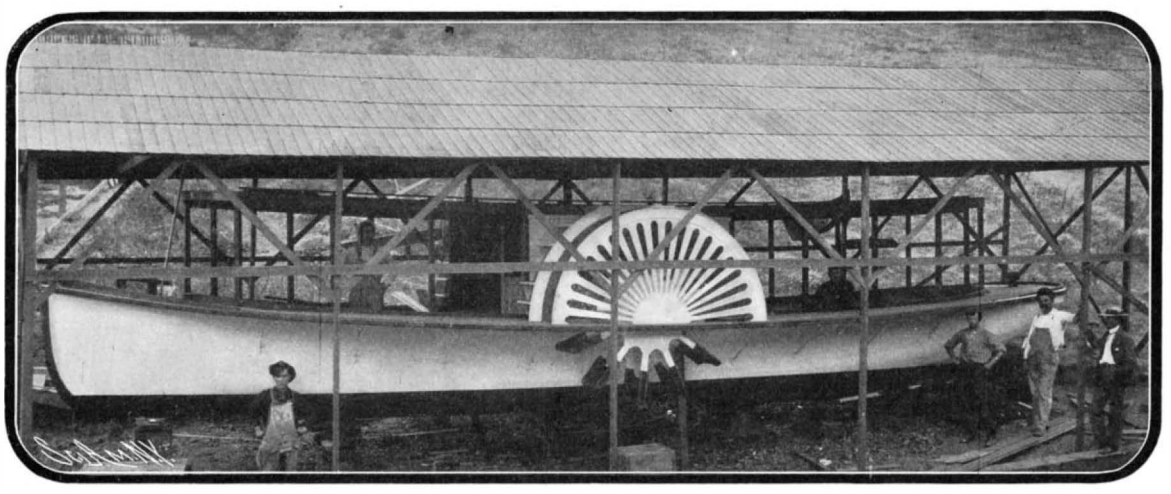
BY CHARLES F. HOLDER.

Some sixteen years ago, when watching the play of fishes along the kelp beds of the Santa Catalina group, the writer described to the boatman a plan for using a "sea window" he had employed on the Florida reef, also the water box for collecting; and from this suggestion has grown an industry illustrated at Avalon by a fleet of so-called glass-bottom boats, whose owners or captains crowd the wharf and shores of this place much as do hackmen in large cities, or gondoliers in Venice. The writer had a boat in Florida which had a well 4 by 6 feet, boarded at the bottom, with perforations, after the fashion of all the smacks at that time, which carried their catch in wells. But the central portion of this well was covered with glass, so that as the boatman poled along over the coral reef, every object could be seen and secured by diving or otherwise. Used with this was an ordinary water box, one end being left open, the other covered with glass, which when placed upon the water, made everything plain and discernible.

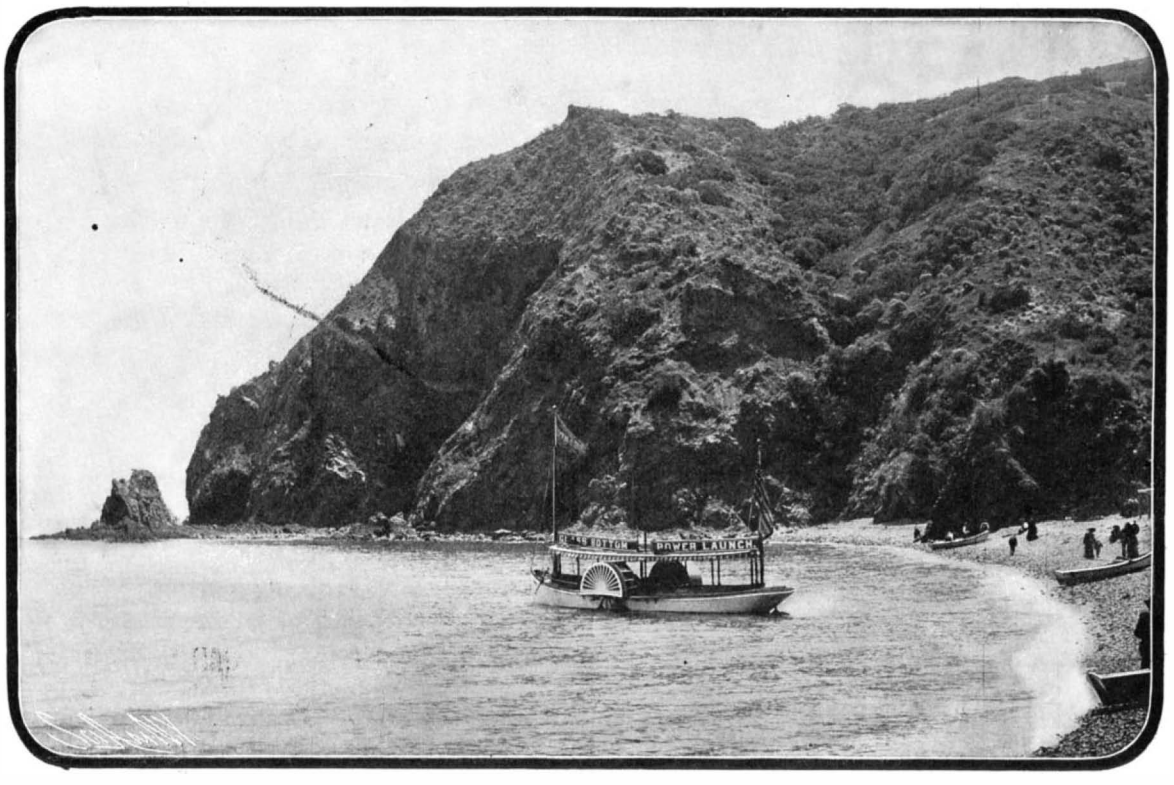
The Catalina boats are built on this plan. A well in the manner described is used, but instead of having a perforated wooden bottom the latter is *all* glass and the well empty, there being no occasion to hold or keep the specimens; the design is merely to see them. The success of this scheme was at once apparent, and many men built boats. Old sailors, who had been masters of ships, now became captains of "glass-bottom boats," while their runners gathered in the streets and shouted the varied attractions of the craft. The first glass-bottom boat was a large flat yawl or barge capable of holding twelve people, possibly more. The well rose about as high as one's knees, and was eight or ten feet in length; the passengers, leaning their elbows on the cushioned rim of the well, literally gazing through a window into the ocean, when every object to a great depth became distinct, affording a beautiful vista of submarine scenery, appreciated by the landsman, to whom it was a remarkable novelty.

The kelp beds of Santa Catalina lend themselves particularly to this, being in smooth water in Avalon Bay and very beautiful. The first glass-bottom boat was propelled by a man who sat forward and rowed, also acting as a guide, pointing out the wonders of the deep with no sluggish imagination. As the fame of the glass-bottom boat spread afar, new and time-saving methods became necessary, and the motor glass-bottom boat appeared. This was a catamaran with a house on deck and a screw and engine astern; but it promptly sank, and no one could be induced to enter the box; indeed, there was always a certain percentage of "riders and seers" who were suspicious of the "window." What if the glass should break?—forgetting that water would not rise in the well higher than it was on the outside.

The evolution of the glass-bottom boat continued, and finally some venturesome spirit built a large power boat with a commodious well which carried successfully a large number of passengers. This boat is here shown just before launching and afloat. She was of peculiar build, being very flat, so that she could pass over the floating kelp and run in the shallowest water. As a propeller or screw would tangle in the kelp, this feature was avoided by using old-fashioned side paddle-wheels made very shallow, so that they just caught the water and did not catch the weed. The boat represents for the present the perfection of the glass-bottom boat, which is, in a way, a liberal education in marine zoology, affording as it does opportunities to observe rare and singular objects.



THE GLASS-BOTTOM BOAT.



THE GLASS-BOTTOM BOAT NEAR MOONSTONE BEACH, CATALINA ISLAND.

The Death of Henry Carrington Bolton.

H. Carrington Bolton, well known for his chemical bibliographies and chemical investigations, recently passed away. An article of his in the American Chemist, 1876, exemplified in telling words one of the great aims of his life, with the fruitful accomplishment of which all are familiar:

"So rapid are the strides made by science in this progressive age and so boundless is its range, that those who view its career from without find great difficulty in following its diverse and intricate pathways, while those who have secured a footing within the same road are often quite unable to keep pace with its fleet movements and would fain retire from the unequal contest. It is not surprising, then, that those actually contributing to the advancement of science, pressing eagerly upward and onward, should neglect to look back upon the labors of those who precede them and should sometimes lose sight of the obligations which science owes to forgotten generations." His numerous contributions to and intimate knowledge of the history of chemistry, his gentle and generous sympathy, aided and stimulated many active in research or technical applications of chemistry. His monumental bibliographies put out by the Smithsonian Institution are masterpieces.

Some interesting experiments with a new steel process have been in progress at Pontymister Works, near Newport, England. Investigation has resulted in the discovery that by the use of a secret alloy, steel suitable for making tools can be produced from Siemens steel, instead of only from crucible steel. The result is that a considerable saving is effected in the cost of manufacture. Should the experiment be successful, it is anticipated that a new industry will be created, and the whole system of steel manufacture revolutionized.

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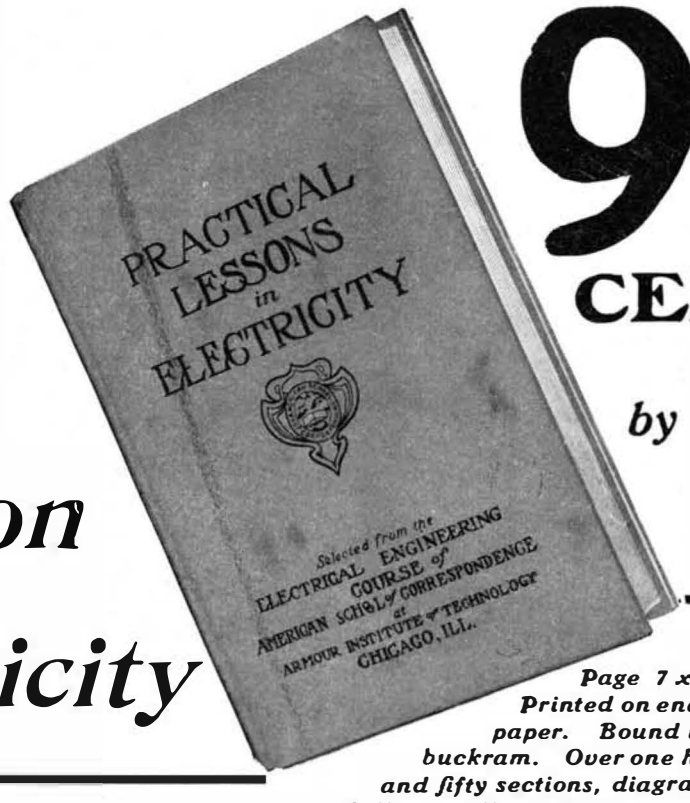

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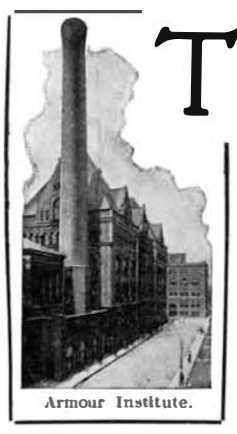
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Every automobile owner ought to know the general principles of electricity and storage batteries as given in the Practical Lessons. Wiring is given as required by the National Board of Underwriters. The subjects embraced are:

STORAGE BATTERIES. By PROF. F. B. CROCKER, COLUMBIA UNIVERSITY (prepared especially for home study): Types; General Principles; Chemical Action; Data Sheets; Edison Storage Battery; Management; Electrolyte; Cadmium Test; Charging; Efficiency; Troubles and Remedies; Testing; Portable Batteries for Automobiles and Boats, etc.

ELECTRIC WIRING. By H. C. CUSHING, Jr. (author of "Standard Wiring"): Dynamo Installation: The Switch Board; Lightning Arresters; Motor Installation; Tables; Transformers; Three-Wire System; Poles and Pole Setting; Inside Wiring; Arc Light Wiring; Conduit Work; Fixture Wiring; Cut-outs; Switches; Distribution of Light; Arc and Incandescent Systems; Fuses; Inspection, etc.

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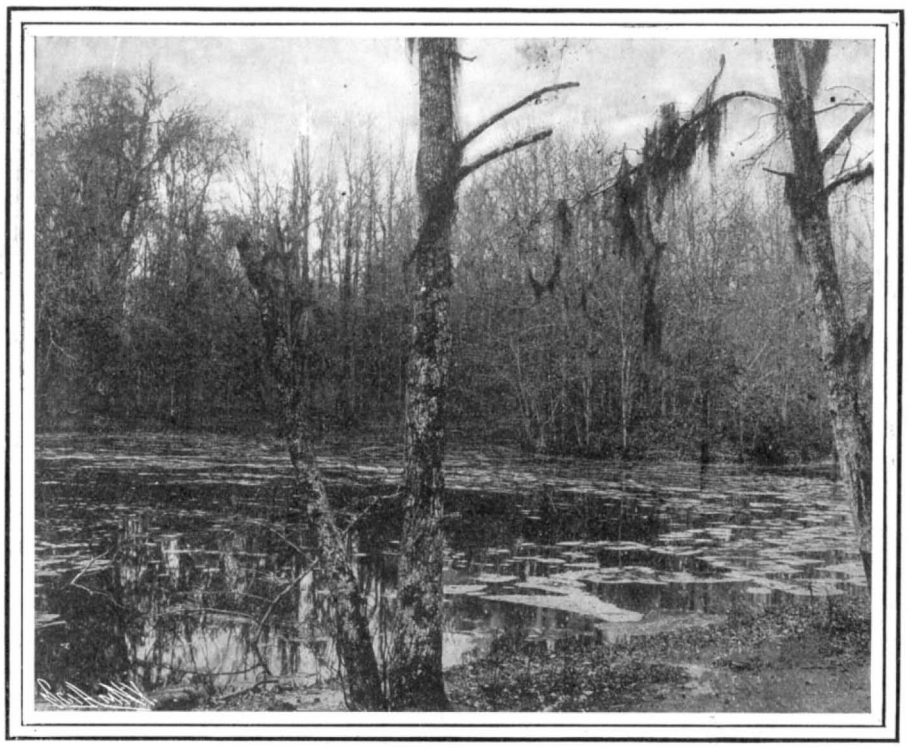
NEW TEXAN OIL DEPOSITS.

BY DAY ALLEN WILLEY.

The extent of the petroleum deposits which underlie portions of the States of Louisiana and Texas is a problem which remains to be solved, but the results which have thus far been obtained in sinking wells show that a very considerable area of territory contains oil in large quantities and that in some instances several deposits may exist, one beneath another. At the time the Beaumont district became exploited through the famous Lucas well, the opinion prevailed that this section contained the great bulk of the petroleum existing in the Southwest, owing to the enormous flow from the Lucas and other wells. It is estimated that the former would gush about 50,000 barrels every 24 hours until it was brought under control. After the Beaumont district became what oil men call a pumping proposition, no very large wells were brought in until the latter part of 1903, when a gusher, which is asserted to be second only to the Lucas in the quantity thrown out, was struck at a place called Batson's Prairie, 14 miles north of Sour Lake and about 30 miles from the Beaumont district. A well which reached the oil-bearing strata on December 1 began flowing at a rate of 500 barrels daily. The same company was also engaged in boring a second well on its property. This reached the oil about December 20, and it began flowing at what oil operators claim to be a rate of probably 30,000 barrels every 24 hours. Heretofore few signs of oil have been found in the locality, and the "strike" came in the nature of a surprise, with the result that prospectors and investors have left other portions of the Southwest by the score, and are buying land and boring wells as near the gusher as they can locate.

The Beaumont oil boom attained its height during the first six months of 1901. During the last two years, however, other districts in Texas and Louisiana have been exploited sufficiently to prove that several other fields undoubtedly contain a very large quantity of oil. They include the Sour Lake and the Saratoga in Texas, as well as that at Batson's Prairie, the scene of the latest development, and the Jennings district in Louisiana. During 1901 the idea of boring for oil in the vicinity of Sour Lake was agitated, and early in 1902 enough producing wells were sunk to cause an influx of people and capital, many deserting Beaumont for the new district. Sour Lake, which is located 18 miles west from Beaumont, takes its name from a small body of mineral water fed by springs, and up to the time of the oil discovery had been a health resort. In its vicinity is an extensive pine forest bordered by prairie. The woodland as well as property immediately around the lake were taken up so rapidly by oil operators, that already several hundred derricks have been erected, many of them of the timber which came from the pine trees cut down to make space for them. While no very large wells have been struck, there are a number steadily flowing at a rate of 300 barrels. One of the notable facts is that so few of the wells have failed to reach the oil deposit. At present this territory is producing nearly 300,000 barrels monthly, and is contributing a large quantity of the oil which is being refined in the Texas plants, as it is connected with the refineries, also Port Arthur, by pipe lines. The Sour Lake district as yet is confined to a very small area, but the wells are so near together that one can see rows of twenty and more extending through lanes which have been made for them in the pine forest. The best indication of the development of this field perhaps is shown in the growth of the town of Sour Lake. Two years ago this was a stretch of uninhabited prairie, but on January 1 its population was estimated at over 10,000, while the people are coming into it so rapidly that it will probably have 15,000 by the beginning of 1905, if not more. As in the case of the Beaumont field, property values have risen to fabulous prices by reason of the discovery, land selling as high as $30,000 an acre, which originally could have been bought as low as $15 and $20 an acre. The Saratoga field, which is situated 30 miles northwest from Beaumont and 12 miles from Sour Lake, began to be developed with the decline in production at Beaumont. At present it is producing about 1,000,000 barrels yearly, some of which is piped to the refineries, but a large quantity is stored, as the companies have an extensive reservoir capacity. With the exception of the two wells referred to no others of importance have yet been struck in the Batson's Prairie district; but so many are being bored that its production will probably be greatly increased within the next few months, unless it should happen that the original wells had been dug into what the miner would call a pocket, containing only a small quantity of petroleum.



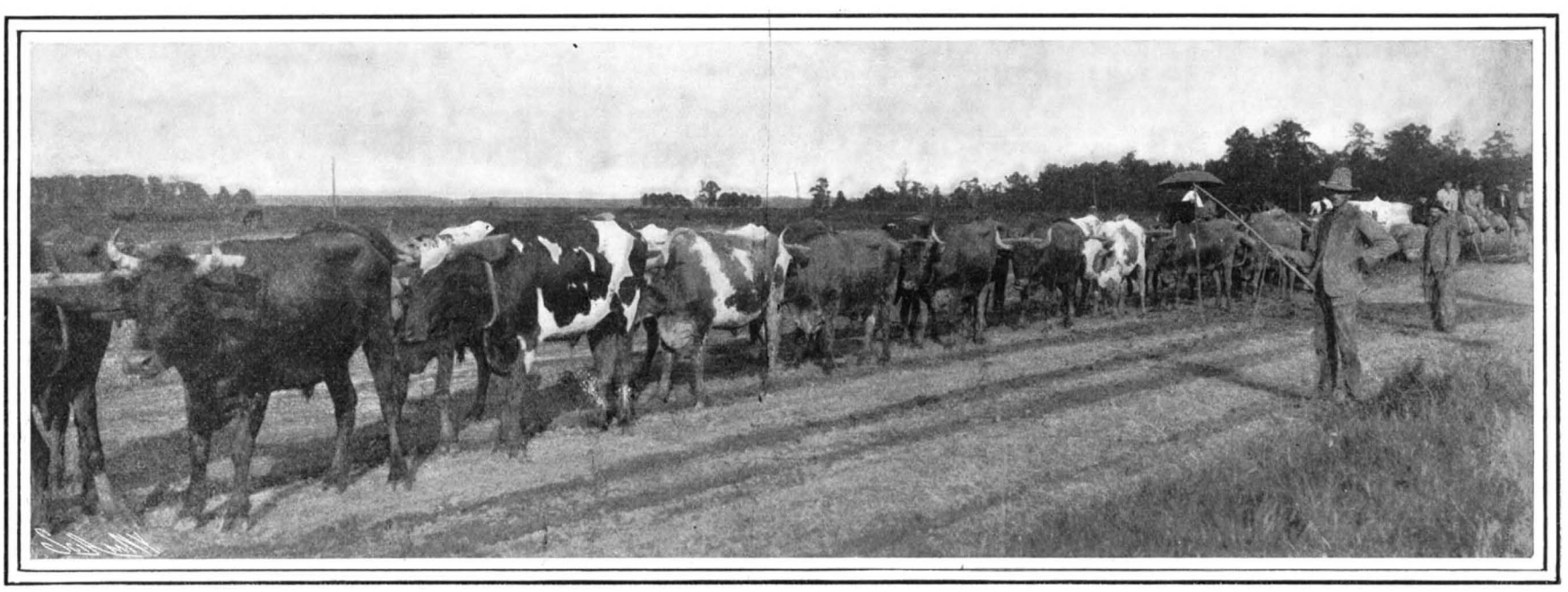
A LAKE OF OIL.

SCENE IN THE OIL FIELDS, SHOWING THE CLOSENESS OF DERRICKS.

The oil-bearing territory of the Southwest has been termed the Gulf coast oil field. Geologists who have thoroughly examined this section of the United States are of the opinion that it extends from a point about 150 miles west of New Orleans, in Louisiana, a distance of fully 150 miles. It is parallel with the Gulf of Mexico, and varies considerably in width. The most important developments in the eastern section of the oil-bearing region are at Jennings, which was developed about the same time as Beaumont, and where some very large wells have been struck. The Jennings district is still producing in large quantities, and the indications are that it has a very extensive supply. Although but a comparatively small portion of the Gulf coast field has been tested by the well-borer, as is indicated, oil in large quantities has been found at its extremities; and if the area which thus far has not been examined produces in the same proportion as those which have been developed, there is reason to believe that the supply from the entire field is so large as to be inexhaustible, and that in a few years it will become one of the greatest petroleum-producing sections on the globe, not excluding the Baku fields or those of Pennsylvania or West Virginia.

That deposits of petroleum lie beneath one another is proved by the experience of the well diggers. At Beaumont, oil was reached at depths ranging from about 900 to 1,100 feet. The larger wells near Jennings were struck at a depth of over 2,000 feet, while at Batson's Prairie the wells range from 750 to 1,200 feet in depth. Oil is found at Sour Lake and Saratoga at about the same depths as at Beaumont.

The probabilities are that only an occasional gusher will be struck in the Southwest in the near future; but so many wells are producing steadily and abundantly by means of pumping machinery, that pumps



HAULING A LOAD TO THE OIL FIELDS.

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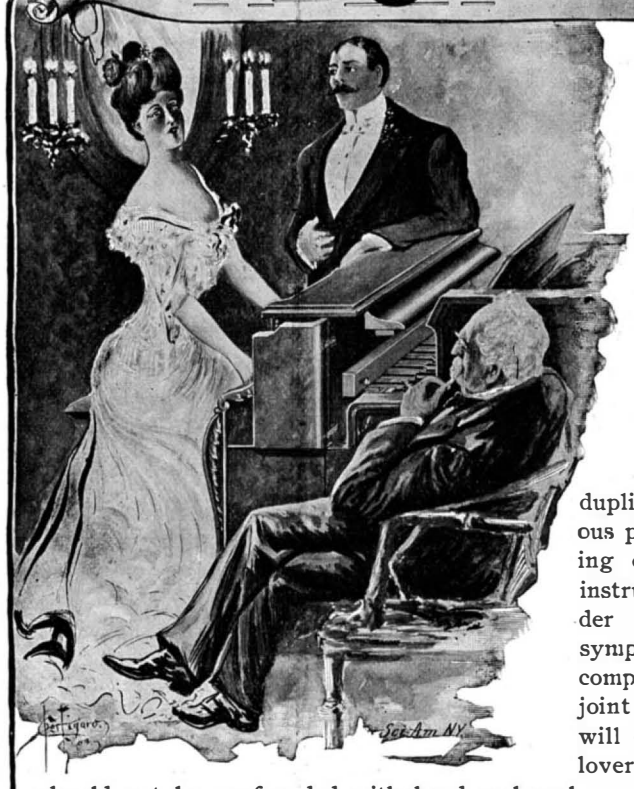

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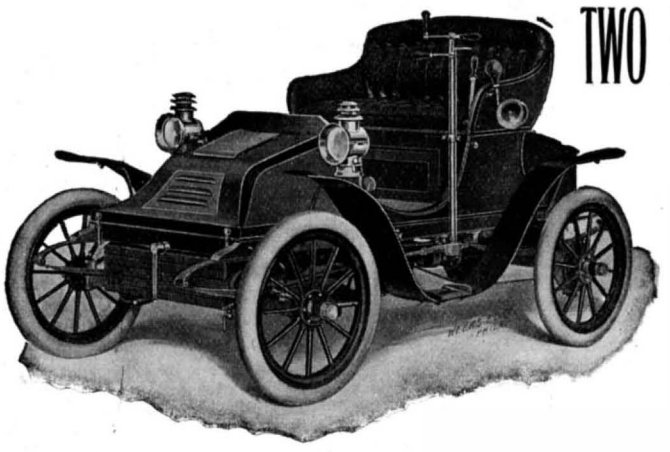

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operated not only by steam, but compressed air and electricity, have been installed very extensively. The oil operators are also exercising much care in husbanding the supply, and construct reservoirs and pipe lines as the wells are dug, in order to secure the output from the beginning of the flow. The reservoirs are of several kinds. Steel tanks have been erected on a large scale, as well as vats made of cypress wood.

Earth reservoirs are still used, although they are a decided improvement upon those which were hurriedly excavated in the early days of the development. Very few of them are open trenches. Dug out of the prairie, they are lined upon the side with hard clay or concrete, sometimes planking tightly fitted together, while the bottom is generally made of concrete. Over the top is laid a roof of wood covered with asbestos or some other weatherproof material. This form of reservoir is economical in construction, while it has the advantage of holding a large quantity of oil and keeping it free from impurities, although it does not offer as great storage facilities as the steel or wood tanks. The Texas field at present has a reservoir capacity of fully 20,000,000 barrels, but the refineries are taking a large share of the product, as the construction of these plants has been rapidly increasing, and over twenty have been erected since 1901. One which was built at a cost of $4,000,000 is among the largest in the world.

STARFISH AND THEIR INJURIES.

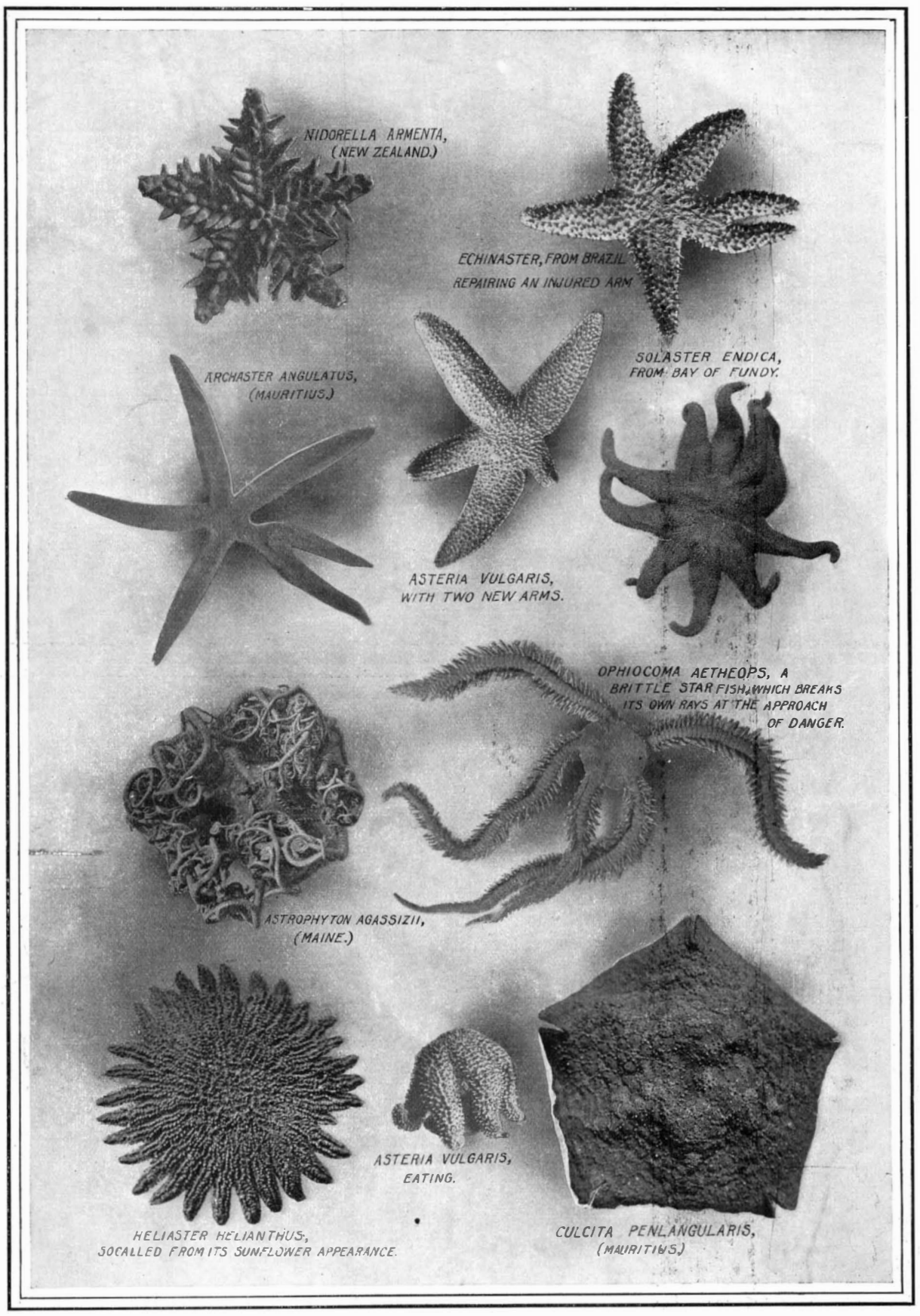
BY W. FRANK M'CLURE.

Crippled starfish offer a most interesting subject for study among the inhabitants of the deep sea. Very many of them are to be found in the ocean depths, just as there are large numbers of maimed people to be seen on land. The collector seeking perfect specimens will perhaps pass by the crippled starfish, while others will find in their deformity a wondrous thing. In Ashtabula, O., there is a rare collection of several hundred starfish cripples owned by Dr. F. D. Snyder, who is a member of the American Association for the Advancement of Science. Some samples of this, in many ways, remarkable collection, which also includes perfect specimens from widely-separated sources, are pictured in the accompanying photographs.

Unlike man, the starfish which loses one of its "arms," or properly its rays, grows a new one to take its place. Under certain conditions it grows two to take the place of one. This latter accomplishment is illustrated in the picture of the *Echinaster*, which was found in South American waters, also in the *Archaster angulatus* from Mauritius. In one of the specimens of *Asteria vulgaris* injuries to two arms will be noticed, with the wounds healed and new growth started. In the case of the *Echinaster* and the *Archaster angulatus*, the growing of the two rays is accounted for by the fact that in the breaking of the original ray it was split. Had it broken off squarely, only one ray would have taken its place. Other forms of cripples will be easily recognized in the photographs.

A starfish may lose all its rays without losing its life, and very often a cripple with but a single ray left is found by fishermen and collectors. When completely broken in two, the starfish becomes two distinct fish, and the growing process continues. The brittle starfish, it is believed, in many instances breaks off its own rays at the approach of danger. For this reason it is difficult to obtain as perfect a specimen as that represented in the illustration of the *Ophiocoma aethrops*, which is owned in Ashtabula, and which came from Panama. These rays are almost intact.

But there are other points in connection with the starfish of the world which are wonderful and instructive aside from the marvelous accomplishments of the cripples. The great variety of shapes alone is beyond the conception of those who have not made deep-sea fish a study. To many people starfish would not be starfish unless they were possessed of rays and resembled in construction a star. To all such the *Culcita pentangularis* will be a revelation. As its name indicates, this fish is pentangular in form. The specimen in the illustration is from Mauritius. Another interesting shape is found in the *Heliaster helianthus*, which derives its name from its resemblance to a sunflower, and which is often found in South American waters. The creature is one of the most beautiful animals that inhabit the sea.


NIDORELLA ARMENTA, (NEW ZEALAND.)
ECHINASTER, FROM BRAZIL REPAIRING AN INJURED ARM
ARCHASTER ANGULATUS, (MAURITIUS.)
SOLASTER ENDICA, FROM BAY OF FUNDY.
ASTERIA VULGARIS, WITH TWO NEW ARMS.
OPHIOCOMA AETHEOPS, A BRITTLE STAR FISH, WHICH BREAKS ITS OWN RAYS AT THE APPROACH OF DANGER.
ASTROPHYTON AGASSIZII, (MAINE.)
ASTERIA VULGARIS, EATING.
HELIASTER HELIANTHUS, SOCALLED FROM ITS SUNFLOWER APPEARANCE.
CULCITA PENTANGULARIS, (MAURITIUS.)

CURIOUS FORMS OF STARFISH.

The manner in which the starfish travels, and the way in which it eats, represent two more interesting features of those queer specimens of deep-sea life. As, perhaps, nearly everyone knows, the starfish can neither see nor hear. Neither has it the sense of smell. In spite of these seeming impediments, nevertheless, it seeks and devours its prey as neatly as an ordinary fish. The starfish lies upon its prey and folds its "arms" or rays completely about it. It then pushes its stomach out through its mouth, and will wrap even a large oyster and shell within the folds of the stomach. The mouth of the starfish is in the center of its rays. The specimen of the starfish eating shown in the photograph is a typical one.

The body of the live starfish is comparatively soft. In traveling, it is said that it fully adjusts itself to the irregular surface of the sea bottom. Passing through an opening of small dimensions is accomplished by pushing one arm through first, at the same time folding the others back sufficiently to admit of forcing the body forward.

Some great ships are to-day employed almost wholly in seeking for starfish specimens in deep seas, and there are hundreds of men who spend a portion of their time in collecting starfish in the interests of science. Many of the specimens collected by ships are taken from depths of one and even two miles. The pressure which these fish withstand at this depth is of course very great.

How Radium is Obtained.

In spite of the fact that the marvels of radium have been so widely discussed and have created such a flurry of excitement not only in the scientific world but among the general public, probably very few people are acquainted with the method by which it is secured in the minute quantities that are as yet available. That the element is obtained from pitchblende is generally known, but some details of the exact process will be of interest. According to the Lancet, operations for the extraction are commenced by crushing the pitchblende, and then roasting the powder with carbonate of soda. After washing the residue is treated with dilute sulphuric acid; then the sulphates are converted into carbonates by boiling with strong carbonate of soda. The residue contains radium sulphate, which is an exceedingly insoluble salt. The soluble sulphates are washed out, and the residue or insoluble portion is easily acted upon by hydrochloric acid, which takes out, among other things, polonium and actinium. Radium sulphate remains unattacked, associated with some barium sulphate. The sulphates are then converted into carbonates by treatment with a boiling strong solution of carbonate of soda. The carbonates of barium and radium are next dissolved in hydrochloric acid and precipitated again as sulphates by means of sulphuric acid. The sulphates are further purified and ultimately converted into chlorides, until about 15 pounds of barium and radium chloride are obtained by acting upon one ton of crushed pitchblende. Only a small fraction of this mixed chloride is pure radium chloride, which is finally separated from barium chloride by crystallization, the crystals from the most radioactive of the solutions being selected. In this way the crystals ultimately obtained are relatively pure radium chloride of a very high degree of radio-activity.

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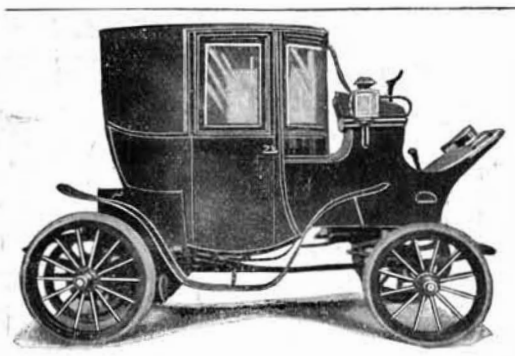

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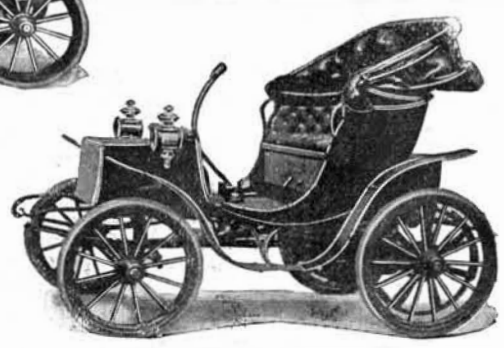

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Inquiry No. 5032.—For makers of toy balloons, rubber and other materials.

For sale outright or on royalty patent 744,468. Pat. November 17, 1903. An improvement for felting machines. O. A. Bremer, Box 385, Burlington, Iowa.

Inquiry No. 5033.—For makers of the necessary machinery and equipments for manufacturing floor and table oil cloth.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 5034.—For manufacturers of auto tricycles.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, machinery and tools. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 5035.—For parties to manufacture cross cut saw handles.

Wanted—Revolutionary Documents, Autograph Letters, Journals, Prints, Washington Portraits, Early American Illustrated Magazines, Early Patents signed by Presidents of the United States. Valentine's Manuals of the early 40's. Correspondence solicited.

Inquiry No. 5036.—For machinery for making paper, using rice hull as a raw material.

Inquiry No. 5037.—For machinery for manufacturing safety matches.

Inquiry No. 5038.—For makers of burning and cauterizing irons. Also for tanners who supply such leather in quantity.

Inquiry No. 5039.—For manufacturers of machinery for making paraffine and stearine wax.

Inquiry No. 5040.—For machines making glycerine, machine to be run by gas or oil engine.

Inquiry No. 5041.—For manufacturers of brass and copper wire and brass and copper rod, in various sizes.

Inquiry No. 5042.—For manufacturers of diving suits and apparatus suitable for work in rivers of not more than 50 feet deep.

Inquiry No. 5043.—For makers of ice machinery for manufacturing ice on scale of about five tons daily.

Inquiry No. 5044.—For manufacturers of gas mantles and supplies.

Inquiry No. 5045.—For manufacturers of incubators.

Inquiry No. 5046.—For manufacturers of tin mechanical toys.

Inquiry No. 5047.—For machines and tools for a machine shop equipment.

Inquiry No. 5048.—For manufacturers of turbine engines of about 50 h. p.

NEW BOOKS, ETC.

THE CONSTANTS OF NATURE. Part V. A Recalculation of the Atomic Weights. By Frank Wigglesworth Clarke. New edition, revised and enlarged. Washington: The Smithsonian Institution. 1897. 8vo. Pp. vi, 370.

Those who are at all familiar with the tables issued by Mr. Clarke some twenty years ago, under the title "Table of Specific Gravity for Solids and Liquids," will appreciate the task of correcting and amplifying that work. Since 1884 there has been a remarkable activity in the determination of atomic weights. Much new material has accumulated, the assimilation of which in combination with the old data being the object of Mr. Clarke's present book. In his introduction Mr. Clarke has outlined the method which he has adopted in discussing and combining results of previous investigators. The chief value of the work lies in the fact that the data have been brought together and reduced to common standards, and for each series of figures the probable error has been determined. Mr. Clarke's work will undoubtedly be welcomed by chemists as perhaps the most valuable contribution to the subject of atomic weights which has appeared within the last decade.

PRACTICAL LESSONS IN ELECTRICITY. Elements of Electricity and the Electric Current. By L. K. Sager. Electric Wiring. By H. C. Cushing, Jr. Storage Batteries. By Prof. B. Crocker. Selected from the Textbooks in the Electrical Engineering Course of the American School of Correspondence, Armour Institute of Technology. Chicago, Ill. 1903. Square 8vo. Pp. 63, with an Appendix. Price 90 cents.

An examination of this work convinces us that the purpose for which it was issued, namely, to give the public an opportunity to judge of both the standard and scope of the instruction offered in the electrical engineering course of the American School of Correspondence at Armour Institute of Technology, is more than fulfilled. The book consists essentially of four parts, all distinguished by a common-sense treatment of a subject, which, particularly in its elementary conceptions, is apt to confuse the average student not a little. Prof. Crocker's wide experience as a teacher is apparent in the division on storage batteries. That portion of the work is characterized by a lucidity of treatment which is unfortunately not often found in books upon so recondite a subject. Mr. Cushing's division on electrical wiring may be regarded as an epitome of his well-known work on standard wiring—a simple, condensed account of what a fairly advanced student ought to know of this particular branch of applied electricity. Mr. Sager has performed what may well be considered the most difficult task allotted to any of the authors of this book, namely, that of presenting as tersely as possible the elementary conceptions of electricity. His first division on the rudiments of electricity follows more or less the beaten path of Silvanus Thompson and other writers of elementary textbooks. In his division on the electric current, he has outlined with the help of fairly simple mathematics the work which the electric current is capable of performing. Not the least valuable part of the book to the student is a series of examination papers pertaining to the subjects treated.

THE UNIT BOOKS.

We have received from Howard Wilford Bell, 259 Fifth Avenue, New York, several copies of the "Unit Books," so termed because they consist of units of twenty-five pages each and are sold by the unit. In the series of unit books thus far contemplated are included various works on history, science, literature, and the arts. Each book is sold at a price based on its length. A book of 250 pages consisting of ten units costs ten cents. Although it may be commercial, this system of publishing has certainly the merit of being fair. From the book-making standpoint it must be confessed that the specimens which we have received are excellent examples of the printing art. Set in Scotch Roman type, printed on feather-weight paper, and neatly bound, the books present an appearance which is exceedingly attractive. Mr. Bell's idea lends itself very well to the publication of literary masterpieces. We should like to see a few scientific works included in his list—a few of Huxley's and Tyndall's lectures, for example.

NEW THOUGHT PRIMER. By Henry Harrison Brown. San Francisco: "Now" Folk [Publishing Company]. 1903 16mo. Pp. 64. Price 25 cents.

SMALL ELECTRIC MOTORS: HOW TO MAKE AND USE THEM. London: Dawbarn & Ward. 1903. 16mo. Pp. 75. Price, 20 cents.

THE FIGHTING CHANCE. THE ROMANCE OF AN INGÉNUE. By Gertrude Lynch. Illustrated by Bayard Jones. New York: Smart Set Publishing Company. 1903. Crown 8vo. Cloth. Price, $1.25.

THE VULGARIANS. By Edgar Fawcett. Illustrated by Archie Gunn. New York: Smart Set Publishing Co. 1903. Crown 8vo. Price, $1.00.

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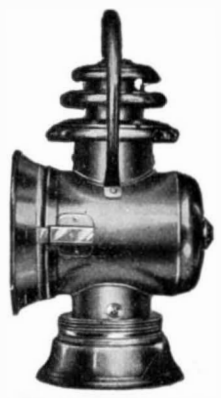

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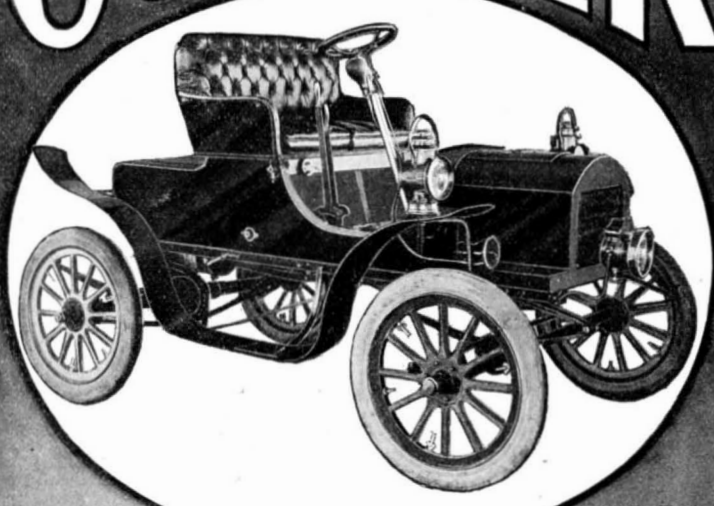

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INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending January 19, 1904.

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

Acid and esters thereof, making acetylsalicylic, B. Balthazard 749,980
Acid and making same, homologous propiolic, C. Moureu 749,800
Acid, ether of amylpropiolic, C. Moureu .. 750,212
Acid, etc., ether of propiolic, C. Moureu .. 750,213
Adjustable bracket and support, A. Anspach 750,045
Air brake, G. Westinghouse 750,010
Air brake safety device, C. Truman 749,809, 749,810
Altiscope for submarine boats, L. Y. Spear 749,754
Altiscope or the like, L. Y. Spear 749,755
Amalgamator and concentrator, J. B. Rossman 750,224
Amusement apparatus, A. F. Mueller 749,941
Angle indicator, R. L. Turner 749,976
Arbor, F. Barter 750,078
Arbors, mechanism for attaching end plates to, Simpson & Nelson 750,231
Atmospheres, apparatus for supplying various, O. E. Boggs 750,155
Atomizer, coin controlled, W. C. Meyer 749,874
Attemperating device, M. H. Shoenberg 750,038
Automobile, electrical, T. A. Edison 750,102
Awning fastener, J. W. Stevenson 750,070
Axle, vehicle, F. R. A. Mackinnon 749,902
Bag. See Cotton picker's bag.
Bag handle, J. Mehl, Jr. 749,997
Bag holder, Denise & Buck 750,174
Bale tie, W. B. Curtis 749,847
Baling press, A. C. Tinsley 749,759
Baling press, E. D. Smith 750,232
Basin strainer attachment, wash, D. B. Allen 750,043
Battery plate, O. Frank 749,785
Bed pan, A. C. Eggers 750,103
Bed, sofa, J. Harvey 749,789
Belt holder, E. E. Robertson 750,222
Belt shifting mechanism, H. A. Houseman. 749,863
Bit, B. W. Kindig, Jr. 750,199
Blind or shutter, window, G. Jarrett 749,966
Block system, electric, F. C. Robinson 750,223
Boot attachment, J. T. Dailey 750,097
Bottle, J. E. Schneider 750,129
Bottle attachment, non-refillable, J. J. Flanagan 750,050
Bottle closure, F. Recht 750,220
Bottle closures, producing, F. Recht 750,124
Bottle packing case, B. F. Martin 749,741
Box, C. B. Baldwin 749,892
Brake mechanism, R. E. Olds 749,903
Brake releasing device, Harrison & Huntoon 750,031
Brake slack adjuster, W. J. Keville 749,967
Brick machine mold, H. J. Flood 749,781
Brick making machine, W. R. Oberdahn .. 750,059
Bridge, E. H. Arnold 749,771
Bridge cross tie, J. B. Logan 750,208
Bridle and bit, B. W. Kindig, Jr. 750,200
Bucket, minnow, Wilson & David 750,143
Bucket suspension device, two rope, J. S. Foster 749,784
Buckle, H. L. Perryman 749,879
Buckle, J. S. Sourek 749,953
Buckle, back band, W. H. Hart 750,109
Buckle fastener, belt, H. M. Rosenblatt .. 750,064
Buckle, garment, W. H. Johnson 749,995
Building block and wall, F. E. Kidder 749,796
Building section, W. A. Warner 749,762
Burglar alarm, safe, H. R. Cassel 749,842
Butter, making, J. Estep 749,853
Button, Fogel & Bourke 749,856
Cabinet, F. J. Saiger 749,884
Cable clip, O. C. Hoffmann 749,988, 749,989
Cable grip clamp, E. J. Brown 749,896
Cable making machine, J. H. Schoonmaker 749,752
Cage trap, A. B. Hendryx 749,790
Calculator, E. C. Duncan 749,851
Cameras, means for attaching supplementary parts to photographic, H. W. Locke 749,738
Car construction, metallic, C. M. Carnahan 750,049
Car coupling draft rigging, E. S. Woods .. 749,829
Car door, grain, E. E. Kenfield 750,111
Car door, grain, J. Barry 750,149
Car steam heating system, railway, N. Nilson 749,970
Car switching apparatus, M. Brosnan 750,162
Cars, electrical controller for railway, H. P. Wellman 750,139
Cars, sleeping appliance for passenger, I. B. Guenzburg 749,930
Carbureted air, apparatus for producing, E. F. Wilson 749,768
Carbureted air, producing, E. F. Wilson 749,767
Card shuffler, playing, H. F. H. Newington 750,216
Case, J. F. Prentice 750,122
Casein compound and producing same, H. K. Brooks 750,048
Cash register, T. Carroll 750,086
Casket handle, J. McCarthy 750,001, 750,002
Casket, hermetical, W. A. Warner 749,783
Centrifugal machine, J. J. Berrigan. 750,079, 750,080
Chair. See Folding chair.
Checkrein, W. H. Fuller 749,929
Chemical changes, effecting, A. H. Cowles 750,096
Chill, J. W. Fuller, Jr. 749,928
Chuck, lathe, F. R. Inman 749,794
Cigar cutter and match igniter, combined, J. T. Galetti 749,964
Circuit controller, vibratory, R. Varley 750,040, 750,041
Clamp, Hanson & Bentley 749,732
Clevis plow, M. Wheeler 749,889
Clothes line securing device, J. Blasius 750,081
Coal handling apparatus, J. M. McClellon .. 750,003
Coffee, etc., apparatus for making, F. W. Dallinger 749,777
Coil, Ruhmkorff, R. Varley 750,039
Comb, W. S. Bechtold 750,238
Composite block for soft treads and making same, C. W. Zaring 749,978
Concentrator, W. G. Anderson 750,075
Concrete structures, T-iron bearer for, T. Franke 749,987
Confection coating machine, J. P. Annen .. 750,076
Conveyor, W. J. Patterson 749,803
Cooking device, J. Henault 750,190
Copy holder, F. C. Shobert 750,230
Copy holding device, J. R. Foster 749,783
Cotton chopper, D. Washington 750,138
Cotton picker's bag, Dalton & Walker 749,722
Cover, vessel, B. L. Johnson 749,993
Crate, Nagle & Prouty 749,946
Cultivator, C. V. Barnhart 749,833
Cultivator, rice, H. D. Dodd 749,960
Cultivator, two row lister, A. V. Ryder 749,906
Curtain bracket, A. Lambert 750,055
Curtain bracket, adjustable, R. T. Green 750,027
Cutting machine, E. F. Gibbons 750,107
Cutting machinery, T. C. Hansen 749,820
Cycle free wheel and brake attachment, W. Powell 749,950
Cycle saddle for supporting rifles, etc., J. Jarvis 749,865
Cycles or the like, saddle for, T. G. Stevens 750,069
Dental articulator, L. Knight 750,203
Dental cement injecting tube, H. L. Cruttenden 749,846
Dental polishing and grinding instrument sprayer, H. H. Gantz 749,899
Detachable handle, L. H. Soisson 749,753
Disinfectants to water closets, apparatus for applying, G. S. Gallagher 749,963
Display rack, M. J. Redding 750,063
Ditching machine, M. B. True 749,778
Draft attachment, spring, G. W. King 750,112
Drawers, J. Gugenheim, et al 750,187
Drier, C. E. Geiger 750,051
Drying machine, F. Wertenbruch 749,828
Drilling apparatus, portable electrically driven, Campbell & Isherwood 749,841
Drilling machine, T. C. Hansen 749,821
Dye and making same, anthraquinone, O. Bally 749,913
Dye, green, A. Luttringhaus 750,113
Egg boiler, J. Anderson 750,072
Electric blanket, C. Foglesong 750,179
Electric furnace, A. H. Cowles 750,171
Electric resistance furnace, A. H. Cowles 750,093
Electric wires, securing, A. Kline 749,867
Electrical energy, means for converting faint vibrations into, W. H. Fahrney .. 749,854
Electrical variations, means for reproducing, P. C. Hewitt 749,791
Electrical variations, reproducing, P. C. Hewitt 749,792
Electrode and producing storage battery electrodes, F. A. Feldkamp 749,855
Electrode for electric tube lamps, D. M. Moore 749,999
Electromagnet, I. A. & E. W. Timmis 750,132
Electromagnetic brake, J. S. Lockwood 750,207
Engine. See Rotary engine.
Engine muffler, hydrocarbon, E. L. Russell .. 749,883
Engine tender, traction, P. H. Sampson .. 750,065
Excavating, raising, screening, and filling gravel ballast, etc., machine for, H. Quertier 750,005
Explosive, H. Dreany 750,175
Extensible trough or flume, P. Maginnis .. 749,871
Eyeglass or spectacle case, W. E. Birmingham 750,017
Fan actuating mechanism, J. F. Carr 750,165
Fanning mill, W. J. Hammill 749,819
Farm machinery seat, C. Wilson 750,142
Faucet, regulable self closing, E. L. Walter 749,910
Feed trough, T. L. Carpenter 749,717
Feeder, steam boiler, J. J. Burke 750,085
Fence, Barnes & Wilmarth 749,714
Fence post, H. McFeron 749,944
Fender, Parisien & Gingras 749,878
Fertilizer distributer, J. Campbell 750,164
Filter tablet, W. G. Tousey 750,235
Fire alarm, electric, Barten & Sneeringer 750,150
Fire alarm mechanism, L. G. Woolley 750,012
Fire alarm system, L. G. Woolley 750,013
Fire escape, V. Jetley 749,736
Fire escape, B. Brielmaier 750,240
Fireproof building construction, C. F. Buente 749,812
Fireproof floor construction, J. Schall 750,066
Fishing reel, R. L. Hunter 750,054
Flood gate and fence, L. W. & E. Phegley .. 750,004
Floor plates, means for producing metallic, M. G. Worth 750,042
Floor scraping and finishing tool, J. S. Hartman 749,861
Flue expander, J. W. Faessler 750,176, 750,177
Fluid circulating apparatus, H. Stier 749,886
Fluid motor, expansive, J. A. Norton 750,217
Fluid pressure regulating device, P. Synnestvedt 749,974, 749,975
Flush tank apparatus, Seager & Kelly 750,228
Folding chair, T. W. Washburn 749,764
Food products, plant for curing, C. B. Trescott 750,133
Foot warmer or heater, O. O. Petty 750,060
Fruit cleaning apparatus, dried, G. Herbert, Jr. 749,931
Fruit picker, P. Pinch 750,061
Fuel feeding system, liquid, D. E. Johnson 749,994
Furnace, T. Murphy 750,214
Furnaces, mechanical rabble for ore roasting or calcining, A. E. Johnson 750,194
Furniture, folding, G. H. Buck 749,915
Fuse, electric circuit, E. C. Phillips 750,244
Gage, R. A. Lachmann 750,204
Gage and marker for dressmakers or others, M. M. Reis 750,221
Game apparatus, J. S. Mather 749,872
Garment fastening, C. M. Shubert 750,008
Garment supporting hook pin, E. C. Herring 750,032
Gas apparatus, F. W. Beardsley 750,016
Gas burner, incandescent, J. W. Bray 750,018
Gas generator, acetylene, O. K. Stuart 749,757
Gas, manufacturing, P. Naef 749,945
Gas or vapor electric apparatus, regulator for, P. C. Hewitt 749,793
Gearing, differential, H. T. Craven 750,172
Gearing, electromagnetic, E. Thordon 750,009
Glass grinding or polishing apparatus, F. F. Fischer 749,961
Glass grinding, smoothing, and polishing table, Marnane & Davies 749,801
Gold saving apparatus, L. Sachse 750,227
Gopher trap, J. J. Daniels 749,848
Grading and ditching machine, B. O. Rhodes 749,747, 749,748
Grain header, J. A. Sharp 749,907
Grain separator feeder, J. B. Cornwall 750,092
Greenhouse frame, H. Simpson 749,972
Grinding device, disk, F. E. Wilkison 749,766
Hammer and rock drill, power, J. Kraus 749,996
Hammer, chain maker's power, W. N. Appleton 749,912
Hammer, pneumatic, Speer & Bowman 749,808
Handle. See Bag handle.
Handle, W. N. Lewis 749,869
Harrow, self cleaning, A. Dixon 749,923
Harvester, corn, S. C. Anderson 749,831
Harvester, corn, H. M. Burdick 749,838
Harvester tongue support and side-draft check, grain or grass, C. F. Ortman .. 750,116
Harvesting potatoes or the like, machine for, C. F. Grohmann 750,029
Hat pin, R. Omlor 749,948
Hay rake, H. A. Adams 749,711
Hay rake, W. Lincoln, reissue 12,194
Heating, electric, A. H. Cowles 750,170
Heating liquids, especially milk, apparatus for, J. Fliegel 749,926
Heating materials, electrically, A. H. Cowles 750,095
Heating system, vacuum and circulatory, G. L. Bottum 750,158
Heddles, producing, W. Fehr 749,725
Heel blank assembling machine, G. B. Grover 749,788
Heeling machine, H. Briggs 750,047
Hinge pin, J. C. Griffin 749,729
Hitching device, W. J. Willey 750,141
Hitching strap, E. J. Fenn 749,726
Hoe, wheel, E. Piggott 750,218
Hook, A. F. Dunn 749,852
Hopple loops, manufacture of, J. P. Kline 750,201
Horse cleaner, G. E. Fredericks 749,727
Hose clamp, V. H. Davison 749,849
Hose supporter, J. B. Carolin 749,918
Hot air furnace, T. F. Meinhardt 750,114
Hot water furnace, F. Lumyer 749,740
Hydrant, W. W. Corey 750,021
Ice cream freezer, J. Prade 750,121
Ice from antennae, device for clearing, De Forest & Clark 750,181
Illuminating prism plate, F. L. O. Wadsworth 749,761
Incubator, G. Hacker 749,858
Injector, S. L. Kneass 750,202
Insect destroyer, J. Ham 750,030
Iris diaphragm, Bausch & Hommel 750,237
Irrigating device, W. G. Templeton 749,758
Justifying mechanism, F. B. Converse, Jr.. 749,720
Kettle, R. Brandt 750,159
Keyboard, transposing, J. H. Brady 750,083
Knitting machine, automatic circular, J. B. Hipwell 749,933
Knitting machine, jamb, A. Greaud 750,052
Knitting machine stop motion, D. H. Hill 749,932
Knitting machine stop motion, G. W. Ruth 750,225
Knitting machine stop motion device, E. Wrigley 750,147
Knotting tool, A. S. Horlacher 750,033
Label or stamp affixer, F. C. Arey 749,891
Lacing, shoe, H. W. Pinkerton 749,904
Lamp, electric tube, D. M. Moore 749,998
Lamp socket, D. A. Schutt 749,952
Lamp socket, incandescent, O. E. Kenney 750,198
Lamps, illuminated sign or number plate for automobile, T. H. Edmonds 749,779
Land anchor, W. G. Beach 750,151
Lantern plug, J. P. Sneddon 749,867
Ledgers, account and record books, files, etc., lock for the adjustable backs of loose leafed, A. D. Hulquist 749,992
Legging, puttie, Allinson & Robertson 749,911
Legging spring, M. Rosenwasser 749,951
Letter package tie, C. S. Kellum 749,935
Ligature tube, B. K. Hollister 749,934
Liquids, apparatus for automatically controlling the flow of, A. Priestman 749,825
Liquids, stoppering device for sparkling, J. Roger 749,749
Lock strike plate, C. Hamel 749,818
Locomotive boiler, J. Wister 750,145
Loom, A. Wolfensberger 749,890
Loom for weaving figured goods, A. Barbier, et al 750,015
Loom weft replenishing mechanism, Baker & Kip 749,979
Lubricator, S. M. Hall 750,053
Mail pouch closure, J. L. McCormick 749,876
Manure spreader, C. W. Smith 750,067
Masonry structures, temporary supporting form for, G. W. Jackson 749,735
Mattress, F. J. Lewzey 749,901
Mausoleum or burial vault, G. Y. Bonus 750,157
Meat cutter or chopper, P. F. Meher 749,873
Mechanical movement, W. H. Voss 750,136
Metallurgical furnace, W. S. Dempsey 750,022
Milk jar locking device, Holle & Stevenson 750,191
Mill. See Fanning mill.
Mixing machine, C. E. & C. T. Foote 749,962
Mop holder, C. Morgan 749,940
Motor, B. J. Delzeit 750,098
Muffler, exhaust, Willis & Andricht 750,011
Music pieces, device for mechanically substituting one disk for another in, A. J. Rod 749,826
Music turner, sheet, E. Douden 750,101
Muzzle, animal, B. P. Merry 750,210
Napkin ring, W. M. Kendall 750,197
Necktie holder, J. W. Van Plew 750,135
Nose ring for animals, E. K. Rea 750,123
Nut lock, J. N. Smith 750,130
Nut lock, W. C. Miner 750,211
Nuts, etc., locking device for, Van Duijn & Van Thiel 749,924
Office indicator, C. F. Ruttman 750,226
Oil can, non explosive, J. Childs 750,089
Oil, refining, J. C. Fleming 749,925
Ophthalmoscope, De Zeng & Reid 750,099
Packaging clip, C. E. Beisel 749,834
Packing, manhole, J. K. Munson 749,969
Packing, valve stem, E. P. Coleman 750,090
Paint sprayer, H. R. Cooper, Sr. 749,774
Paper boxes, machine for manufacturing, J. M. Carncross 749,917
Paper cutting and folding machine, S. D. Ruth 749,905
Paper feeding and stencil printing apparatus, A. B. Dick 749,984
Paper feeding apparatus, Dick & Brasseur 749,985
Paper feeding apparatus, A. B. Dick 749,986
Paper package or sheets and cabinet therefor, toilet, J. T. Hoyt 749,965
Pencils, crayons, etc., device for use in connection with the sharpening of lead, F. E. V. Baines 749,713
Phonograph, E. Gilman 749,857
Phonograph record cylinder, celluloid, A. N. Petit 750,119
Phonographs, etc., aparatus for duplicating sound record cylinders of, A. N. Petit 750,118
Photographic film, graded, E. F. Beckwith 749,893
Photographic prints for toning, preparing, T. Baker 750,014
Pianoforte, F. McNamara 750,035
Pile protector, A. S. Cooper 749,920
Pile strengthener, A. S. Cooper 749,957
Pipe or rod holder, E. E. Townsend 749,760
Pipes, etc., protective covering for, W. H. Washington 749,955
Piston chambers and rings, machine for grinding, J. B. Phillips 750,037
Plane, bench, E. O. Sjolander 749,827
Plane, hand, E. Haydock 750,189
Planing machine, H. B. Ross 750,125
Plotting instrument, N. G. Davidson 749,921
Power transmission device, J. F. Krema .. 749,868
Precious metals by electrolysis, apparatus for extracting, H. R. Cassel 749,844
Precious metals by electrolysis, extracting, H. R. Cassel 749,843
Printing machine, stencil, A. B. Dick 749,983
Propeller, screw, E. A. Nilsen 750,036
Prospecting instrument, M. Chase 749,718
Pulley, split, S. Stroba 749,756
Pump attachment, E. F. Kimball 749,797
Pump automatic controller, feed, R. J. Mullin 749,942
Pump, automatic electric, F. L. Orr 750,115
Pump, bucket, L. A. Brigel, Jr. 749,836
Pump coupling, windmill, C. W. Decker 750,173
Pump cylinder, tank and base plate, W. & J. Boekel 750,154
Pump, sand, F. G. Irvine 750,192
Punch, Etnyre & Whitney 750,024
Rack. See Display rack.
Rail contact shoe, Brady & Jones 749,716
Rail fastening, A. Koppel 749,936
Rail joint, F. Dodson 750,100
Rail tie, J. R. Hubbard 750,110
Railway, S. E. Jackman 750,242
Railway brake, F. Gregoire 750,028
Railway draft rigging, W. T. Van Dorn .. 749,888
Railway draw head and air coupling, combined, L. Lecompte 749,900
Railway gate, electrically operated, Spinrad & Buechting 750,068
Railway signal, electrical operated and controlled, R. D. Peters 750,117
Railway signaling apparatus, J. F. Mickey, et al 749,939
Railway tie and rail fastener, metallic, O. Granberg 749,817
Raising or lowering heavy bodies, apparatus for, C. V. Fowler 749,898
Ratchet tool, Z. T. Furbish 750,183
Razor frame, safety, A. W. Scheuber 749,751
Refrigerator attachment, C. W. McClure 750,057
Relay device, J. P. Downs 749,814
Relay, electrostatic, D. la Cour 749,775
Remnant table, C. E. Mitchem 749,799
Reservoir bottom and expansion joint, Wight & Townsend 749,765
Ribbon winding device, E. S. Nordhoff .. 749,971
Rolling mill, C. von Philp 749,745
Roof joint, sheet metal, J. H. McEvoy 749,943
Rotary engine, C. W. Allen 749,712
Rotary engine, W. I. Cochran 750,169
Rotary engine, W. C. Hamilton 750,188
Rotary engine ... Pittler 750,219
Sail fast... mast hoops, detachable, ... att 749,968
Sanitary closet, electric, J. H. Wilson 749,769
Saw clapboard machine, band, A. J. Burton 749,839
Saw gummer, J. Anderson 750,074
Saw set and jointer, combined, J. Anderson 750,073
Saw setting device, W. F. Arantz 750,148
Saw sharpener, W. J. Winter 750,144
Scenery trimmer, theatrical, J. R. Clancy 749,981
Screw driver, reversible, Z. T. Furbish 750,182
Seal, E. J. Brooks 750,020
Sealing wrench, jar, L. D. Burlingham 750,163
Separator, D. L. Adelsperger 750,071
Sewing machine, buttonhole, C. A. Dahl 749,721, 749,776
Sewing machine drop table, W. Grothe 749,787
Shade bracket, window, J. E. Gill 750,184
Shade roller spear, C. Flagler 749,780
Shaft hanger, Bechtol & Manley 750,153
Shaft reversing mechanism, J. S. Sheppard 750,229
Shaft straightener, H. R. Granger 749,816
Shaft supporter, W. E. Hoyt 749,991
Ship's distant recorder, W. C. Forbes 749,927
Shoe polisher, H. M. Backus 749,832
Sieve, grain, H. K. Clement 750,167
Sign, display, J. Ward 750,137
Signal, J. J. Luyten 749,870
Signaling apparatus, Earle & Goodyear 749,815
Signaling system, electrical, H. P. Clausen 749,982
Skirt, Smith & Malnight 750,234
Sleigh runner attachment, vehicle, H. Thiedemann 749,887
Sleigh, wheeled, J. H. Wolf 750,146
Small arms, Neuber & Tambour 749,877
Smelting furnace, M. L. Trapp 749,954
Smelting materials and producing carbid, A. H. Cowles 750,094
Smoke preventing means, H. H. Hughes .. 749,734
Soldering iron, electrically heated, W. J. Bowen 750,239
Spark arrester, D. S. Child 750,088
Spark production, controlling, L. de Forest 750,180
Speed indicator, T. H. McQuown 749,743
Speed regulator, friction, F. W. Linnert 750,056
Spinning machines, fiber gathering can for, G. Stiehle 750,131
Spinning mule, H. S. Golland 750,026
Spreading machine, C. F. Buck 750,241
Spring. See Legging spring.
Stacker, pneumatic, J. H. Ley 749,737
Stair structure, N. Bois 750,156
Stamp mill, G. C. Richards 750,006
Staples, nails, etc., machine for setting, C. H. Wilkinson 749,956
Stave, composite barrel, F. Brenner 750,019
Steam boiler, F. J. Doyle 749,850
Steam boiler, F. T. Chase 750,087
Steam engine, C. Crompton 749,958
Steam engine for curd cutting machines, W. L. McLean 749,742
Steam generator furnace, F. May 749,938
Steam or internal combustion engine or motor, T. S. James 749,864
Stone cutting and shaping machine, P. Lanigan 749,937
Stovepipe lock, W. A. Petrie 750,120
Strainer, fluid, I. W. Pullman 749,880
Stream motor, T. A. Fidjeland 750,025
Stretcher stand, H. C. Hall 749,731
Stud, etc., metallic, M. Hegbom 749,862
Surgical retainer, A. C. Bernays 749,811
Switch handle, snap, C. A. Clark 749,919
Switch indicating dial, snap electric, C. G. Perkins 749,949
Switching mechanism, electromechanical, W. J. Bell 749,835
Tank ventilating attachment, C. Noller 749,802
Telephone exchange, N. E. Norstrom 749,824
Telephone hook switch, E. E. Yaxley 749,977
Telephone system, central energy, K. B. Miller 749,798
Thresher and separator, harvester, W. V. Allen 750,044
Threshing machine tooth, W. J. Cook 750,091
Throat bag, A. C. Eggers 750,104
Thumb support and root brace for enamel cleavers, F. E. Roach 749,881
Tile, G. G. Fryer 749,786
Time recorder, J. W. Deubner 749,922
Tin can, H. E. Bandlow 750,077
Tire, G. M. Depew 750,023
Tire, cushion, J. Coomber 749,845
Tire, vehicle, J. Q. Work 749,830
Tire, vehicle, E. F. McArdle 750,000
Tobacco leaf stemming machine, W. G. Briggs 750,160, 750,161
Toilet article, E. E. Cleveland 750,168
Tongue, vehicle, M. R. Bruner 749,837
Tool holder, B. M. W. Hanson 750,108
Tool, pneumatic, L. W. Turnbull 750,236
Tower, aerial whirling, J. H. Welsh 750,140
Toy golf player, P. A. Vaile 750,134
Track, cantalever car, E. J. Beard 750,152
Train pipe couplings, device for automatically preventing escape of air from, R. C. Pollock 749,746
Traps, automatic control for return, C. A. Southwick 749,973
Trolley for overhead electrical conductor systems, E. Cantono 749,916
Trolley stand, J. Kermath 749,795
Trousers creaser and presser, E. Graham .. 750,186
Truck and hoist, combined, D. Z. Clay 750,166
Truck, railway, C. Nordell 749,947
Trunk garment holding attachment, D. W. Curtiss 749,959
Trunk strap, R. Forbes ..... 749,7[illegible]
Tug, hame, F. Hauff ..... 749,73[illegible]
Turbine, E. J. Wood ..... 749,77[illegible]
Turbine engine, S. Lount 749,739
Turbine, steam, S. N. Smith 749,885
Turn table, S. Elliott 749,724
Turning machine, automatic, B. T. Magers 750,209
Turning machine, wood, J. R. Binns 749,894
Twine holder, P. H. Cazier 749,772
Type holder, J. E. Schlorff 750,127
Type setting machine, F. B. Converse, Jr.. 749,773
Typewriter attachment, N. J. Smith 750,233
Typewriter carriage return, D. S. Dufur 749,723
Typewriting machine, H. Hochklassen 749,822
Typewriting machine, G. C. Blickensderfer 749,914
Umbrella handle, detachable, E. P. Bevillard 750,046
Umbrella, knockdown, H. Fesenfeld 750,178
Universal mill, A. T. Keller 749,823
Valve, J. J. Rylands 749,750
Valve, E. F. Holinger 749,990
Valve, J. E. Schneider 750,128
Valve, air brake, T. Haley 749,859
Valve and co-operating parts, check, W. & J. Boekel 750,082
Valve gear for Corliss engines, releasing, C. H. Robinson 749,882
Valve mechanism for steam engines, discharge, Ferrari & Whittemore 750,105
Vapor burning furnace, J. H. Fink 750,106
Vehicle brake, N. L. Birchfield 749,895
Vehicle brake, automatic, E. J. Johnson .. 750,195
Vehicle, motor, Packard & Hatcher 749,744
Vehicle, motor, H. M. Pope 750,062
Vehicle mud and dust guard, combined, J. H. Scott 750,007
Vehicle mud guard, King & Quick 749,866
Vehicle seat lazy back, B. C. Place 749,804
Vehicle seat lazy back attachment, B. C. Place 749,805
Veneer drier, A. S. Nichols 750,058
Ventilator. See Water closet ventilator.
Vessel loading or unloading means, H. M. Harding 749,860
Vessel sheathing, R. D. Upham 749,909
Wagon, dumping, E. D. Branch 750,084
Wagon, dumping, G. Kautz, Sr. 750,196
Wagon steering gear, A. McEntee 750,215
Wardrobe, closet, etc., W. C. James 750,193
Washing machine, W. T. Rusk 750,126
Washing machine bluing gage and mixer, E. W. Grace ..... 750,1[illegible]
Washing machine gearing, F. T. Brosi 750,243
Water closet ventilator, C. H. Muckenhirn 749,875
Water purifying apparatus, J. C. W. Greth 749,728
Weather strip, F. Fournier 749,897
Well mechanism, M. E. Layne 750,205
Welt feeding machine, G. D. Clapp 749,717
Wheel rim, vehicle, S. Butler 749,840
Windmill, E. Rue 749,806
Window screen, metal, S. W. Benson 749,715
Wire winding tool, M. E. Layne 750,206
Wire working machine, T. S. Haley 749,730
Wrench, F. Stuart 749,908
X-ray apparatus, portable, E. W. Caldwell 749,813
Zinc blende from ores, separating, Jamieson & Odling 750,034

DESIGNS.

Braid, H. P. von Nostitz 36,746
Cabinet, kitchen wall, R. M. Vernon 36,744
Comb, pompadour puff, B. W. Doyle 36,742
Glass vessel, cut, W. C. Anderson 36,738, 36,739
Key, C. J. Caley 36,740, 36,741
Lighting apparatus, globe support for incandescent, L. R. Hopton 36,743
Spoons or similar articles, handle for, S. J. Large 36,737
Wire fabric, O. R. Hunt 36,745

TRADE MARKS.

Animal dip and insecticides, P. R. Palethorpe 41,929
Antipyretic, Farbenfabriken of Elberfeld Co. 41,927
Antiseptic preparations, J. F. A. C. Wartman 41,904
Biscuits, Austin, Young & Co. 41,894
Bitters and tonic medicines, stomach, H. Kuhn 41,915
Books, E. L. Du Bose 41,882
Boots and shoes, certain named, I. Keiffer & Co. 41,898
Boots and shoes, leather, Boegle Bros 41,897
Boots and shoes, leather, W. F. Cramer 41,912
Brushes, tooth, D. M. Clapp 41,906
Cleaning compounds, Huff & Wedge 41,913
Coffee, J. W. Pope 41,893
Copper pigs, bars, and slabs, Pittsburg & Montana Copper Co. 41,909
Corsets, Weingarten Bros. 41,884
Corsets, Birdsey & Somers 41,885
Flour, wheat, C. R. Maltby & Co. 41,895
Induction coils, Varley Duplex Magnet Co.. 41,908
Lard, tallow, lard compounds, and substitutes for lard, Cudahy Bros. Co. 41,897
Leather, cream dressings for, W. Raum .. 41,890
Libraries, books, periodicals, and pamphlets, portable circulating, Booklovers Library 41,883
Lotions, skin, E. Duael 41,930
Medicinal preparation for certain named diseases, J. D. Riedel 41,917
Medicine for certain named diseases, C. Zifer 41,901
Medicine for internal use, antiseptic, G. Brackett 41,928
Medicines, certain named proprietary, F. Hobart 41,918

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Metal polishes, Raimes & Co. 41,891
Oil cake, vegetable, F. G. Kinney & Co.... 41,898
Overalls, pants and blouse or work shirts M. Loeb & Co. 41,886
Pickles, Sterling Pickling Works..... 41,896
Remedies for cure of anemia, chlorosis, and similar troubles, Dr. A. Gude & Co. 41,920 to 41,924
Remedies for cure of certain named diseases, H. L. Lautemann..... 41,902
Remedies for venereal diseases, Neher, Ruhe & Weiper..... 41,926
Remedy, cough, A. B. Lipp..... 41,900
Remedy for all diseases of kidneys, bladder, stomach, and bowels, Vernal Remedy Company 41,903
Remedy for coughs and colds, J. E. Muse 41,919
Remedy for liver and kidney diseases, tablets containing a, Yellow Actors Company 41,925
Rubber sponges, Russian American India Rubber Co..... 41,905
Shirts, collars, and cuffs, International Shirt and Collar Co..... 41,910
Shoes, leather, M. L. Whitcomb..... 41,889
Soap, F. O. Ives..... 41,899
Suprarenal gland, product of the active principle of the, H. K. Mulford Co..... 41,916
Surgical instruments, metallic, Kny-Scheerer Co. 41,907
Suspenders, Consolidated Manhattan Suspenders Co..... 41,911
Tonic, nerve and stomach, J. B. Wells.... 41,914
Water, purified, Standard Water Purifying Co. 41,892

LABELS.

"Buckeye," for crackers, Toledo Biscuit Co. 10,681
"Clay's Sure Cure for Rheumatism," for medicine, E. J. Kieffer..... 10.689
"Faxon's Black & Green Tea," for tea, W. H. Faxon..... 10,684
"Grell's Rose Leaf Brand Creamery Butter The Butter That Betters the Bread," for butter, H. J. Grell Butter & Egg Co. 10,680
"H. L. C. Tooth Bleach," for dentifrice, L. A. Jackson 10,693
"Kremo Dentine," for tooth powder, T. H. Marshall 10,692
"Martha Washington's Lily of the Valley Cream," for complexion cream, M. M. Benbow 10,694
"Mauna Mountain," for coffee, Acker, Merrall & Condit Co..... 10,683
"Nadine Face Powder," for face powder, National Toilet Co..... 10,691
"Old Kaintuck," for cigars, H. G. Trompeter 10,687
"Salax," for mineral water, E. Roberts.... 10,685
"Salax," for medicine, F. L. McClintic.... 10,688
"Santol," for medicine, H. E. Kelty..... 10,690
"Seed Bolls from Our Potato Fields," for seed potatoes, Johnson Seed Potato Co. 10,678
"Swan Island Brand," for canned salmon, C. L. Benson..... 10,679
"Toledo Flakes," for flakes, Toledo Biscuit Company 10,682
"Wagner's Lithiated Vichy," for artificial mineral water, W. T. Wagner's Sons.. 10,686

PRINTS.

"Adler's Spring Fashions for 1904, for men's apparel, David Adler & Sons Clothing Co. 886
"Art Shirt Waist," for shirt waists, Raymond & Pierce..... 885
"Phenolene," for insect destroyers, A. R. Coulson Co..... 883
"The Excelsior Dressmakers Fitting Saddle," for dressmakers' fitting saddles, M. L. Soule 884

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RECENTLY PATENTED INVENTIONS.

Electrical Devices.

INSULATED SUPPORT FOR WIRES.—L. STEINBERGER, New York, N. Y. The invention pertains to insulated clips, the more particular object being to improve the insulation and to attain certain advantages. The principal object is to insulate the conductor-wire from the hanger devices, span-wires, and poles and also to prevent arcing, surface leakage, and grounding of the current. The ear may be readily replaced when worn out. The insulating-body member will last indefinitely.

INSULATOR.—L. STEINBERGER, New York, N. Y. In this instance Mr. Steinberger's improvement relates to insulators for external use, and more particularly to the type commonly designated as "feed-wire" insulators. With many of the feed-wire insulators now in use considerable difficulty is found in securing insulation, especially where currents of high potential are concerned. The idea is to make an insulator which has considerable strength and in which every precaution is taken against leakage of the current.

Engineering Improvements.

ROTARY EXPLOSIVE-ENGINE.—B. BANTA, and C. MATHEWS, Fenton, Mich. The invention is in the nature of an improved engine designed to actuate under an explosive mixture, reversible under two or more propelling impulses in a single revolution, and it primarily seeks to provide an engine of this character of a simple, compact, and durable nature, in which the use of toothed gear-wheels or disk connections are dispensed with and in which the parts are co-operatively arranged to effect an even and uniform operation and in which the action of reversing speed can be quickly accomplished.

Heating and Lighting.

SAFETY GAS-COCK.—H. J. DOLL, San Francisco, Cal. In this instance the invention pertains to improvements in safety gas-cocks; and the object of the inventor is to furnish a simple device which will insure the complete shutting off of the gas when the key is turned and which will also provide means for regulating the flow of gas independent of the key.

VAPOR GENERATOR AND BURNER.—Q. CRANE and J. RESTINE, San Diego, Cal. This vapor apparatus belongs to that class of generators and burners employed for heating purposes, and the object is to provide features of construction which afford a very simple, inexpensive, practical, and convenient generator and burner that may be placed in the fire-chamber of a heating-stove, a kitchen-range, or a steam-boiler for the generation and combustion of gaseous fuel therein from hydrocarbon liquids.

Machines and Mechanical Devices.

PUNCHING AND SHEARING MACHINE, ETC.—R. NORRIE, Rangoon, British Burma, India. In order to obviate defects in other machines for cutting metal, Mr. Norrie has devised a special form of shears in which instead of only cutting edges a blade works in between two other cutting edges, which has the effect of shearing out strips of the material being cut. This blade is mounted so as to enable the material being worked to pass on either side of it, which enables any length of cut to be made.

AUTOMATIC WEIGHING-MACHINE. — W. BROUGH, Baltimore, Md. In this patent the invention is an improvement in automatic weighing-machines, and is especially designed for use in weighing granular or pulverulent or powdered substances and may be employed to advantage in the weighing of coffee, tea, sugar or the like, and without any wasting of the material.

LIQUID-MEASURE.—H. J. BRANTLEY, Valdosta, Ga., and J. C. BRANTLEY, Marksville, Miss. The invention is an improvement particularly in that class of measures illustrated in an application for a former patent filed by these inventors. The present invention relates to improvements in the construction of the measuring vessel, in the connections thereof with the barrel or cask, so the measuring vessel can be leveled when applied for use, in the means for vending the measuring vessel and the cask, and in other improvements.

ADDING-MACHINE.—F. BURESH, Mapleleaf, Iowa. The purpose in this improvement is to provide a reliable machine of very simple construction and which may be conveniently and quickly operated and applied directly to the columns of figures to be added, and further, to provide an indicator which as the machine is moved down a column to be added will be at the right or at the left, or which may be made to cover or conceal the last figure added.

THREADING DEVICE.—S. B. BATTEY, New York, N. Y. In the present case the object of the improvement is to provide a threading device designed either for hand use or for use on sewing-machines to automatically push the sewing-thread through the needle-eye whenever the device is in active position and the needle moves into an uppermost position.

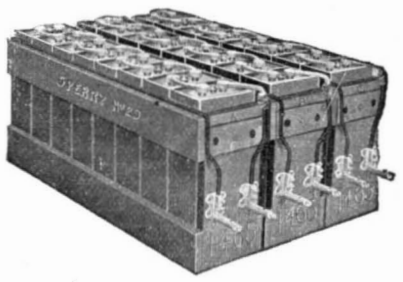
THREADING DEVICE FOR SEWING-MACHINES.—S. B. BATTEY, New York, N. Y. In this patent the purpose of the invention is the provision of an improved threading device for sewing-machines arranged to automatically thread the needle in case the thread breaks, hence requiring no stopping of the machine for threading purposes. The operator may throw the threading device into action at any time in case the automatic thread-controlled device should fail.

ECCENTRIC-SCREW BREECH-CLOSING-DEVICE.—P. DE NORDENFELT and E. TERNSTRÖM, 8 Rue Auber, Paris, France. In this patent the invention relates to an arrangement for facilitating the operation of the eccentric screw, particularly in heavy ordnance. Endeavors have already been made to facilitate such operation by means of bearing-balls on which the screw turns with less friction. However, this means is only an insufficient palliative in the case of heavy ordnance, because it does not diminish the variable resistance arising from the eccentric position of the center of gravity of the screw relatively to the axis around which it rotates.

SELF-THREADING SEWING-MACHINE.—DR. SUMTER B. BATTEY, 152 W. 49th Street, New York, N. Y. To do away with the perplexing necessity of any hand manipulation in threading a sewing machine, the inventor has devised a novel and simple construction of sewing machine, the salient feature of which is the mechanism which operates the threading device. This mechanism comprises a rocking lever, fulcrumed in a vertical slot on the inside of the machine head and operated by a cam in the periphery of a cam disk. The method of operation is as follows. When the machine is started, and the needle-bar in its travel upward has reached the height of its stroke, the cam, which is an offset and at the same time a continuation of a groove around the cam disk, engages the upper end of the fulcrumed lever and causes it to rock outward, thereby imparting an inward motion to the lower end of the lever and passing a plunger, carried by the lever through a guide way for the thread. The thread is thus pushed through the eye of the machine needle, whereupon it is caught by a rotating hook. The needle is then completely threaded before it enters the cloth, the entire operation taking place before a complete revolution of the machine has been completed, and consequently before a stitch has been made. The whole mechanism is thrown out of operation at near the end of the downward stroke of the needle bar and does not work again unless the thread breaks, when the operation of automatic threading is repeated by mere touching of a button.

SHUTTLE-THREADER.—O. R. JACQUES,

SPERRY BATTERIES



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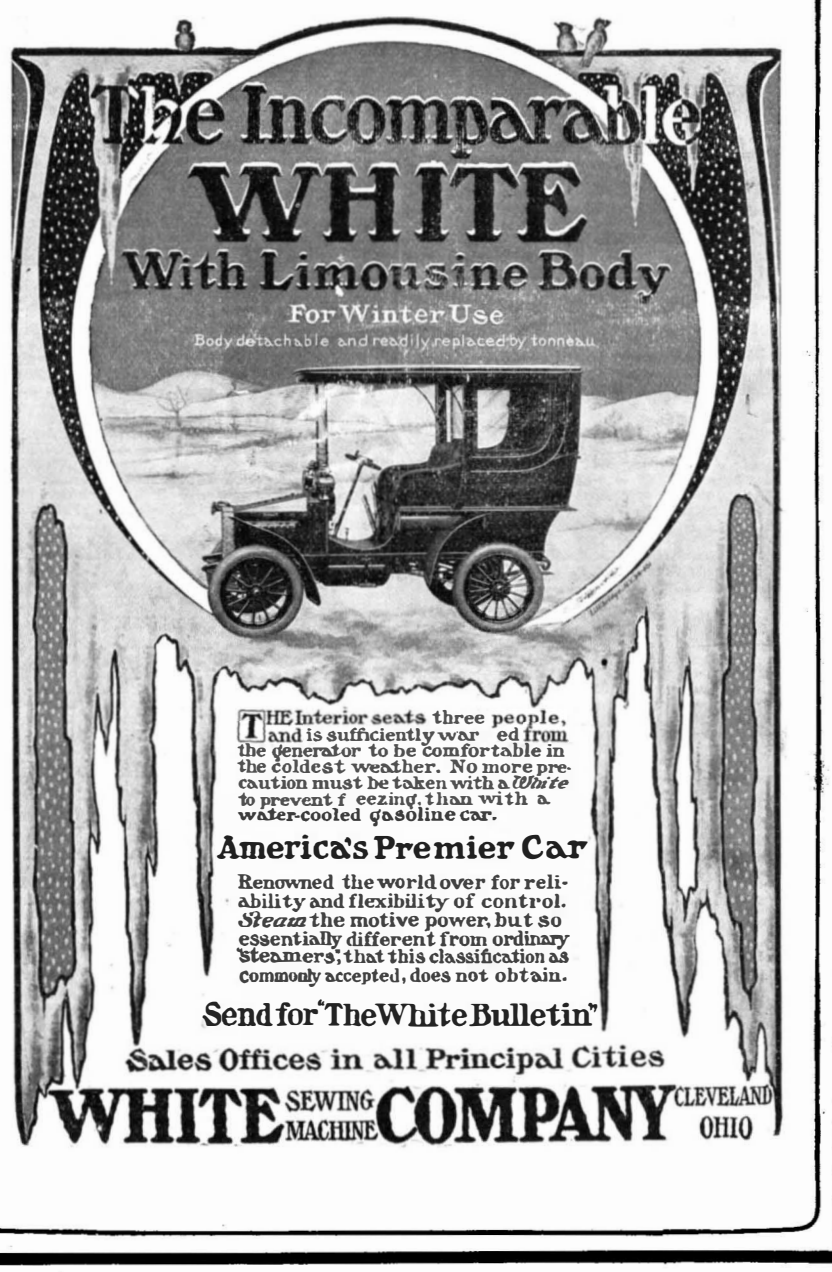
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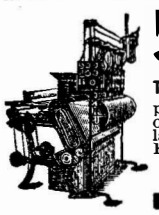

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Manchester, N. H. The object in view is to provide a sanitary device adapted to pneumatically draw a thread through the eye of a shuttle. Mechanical means create a suction in a direction to draw a thread through the eye, and this saves the operator placing an unclean shuttle to the lips, so as to create a suction by inhalation for threading the shuttle, and overcomes the inhalation of particles of dyed yarns and threads, the latter being poisonous to the health.

MACHINERY FOR THE MANUFACTURE OF HORSESHOE-NAILS.—J. M. LAUGHLIN, Fourchambault, Nièvre, France. By this machine all kinds of nails or nail-blanks or finished nails of the French, American, and other types may be made, and it will be understood that the rods from which the blanks or nails are to be cut may be rolled of any form to suit the type of nail-blanks or nails to be made. For instance, the rod intended more particularly for making French nails may be rolled so as to present the same profile on both faces. The machine is also adapted for directly cutting out completely-finished nails. The nails are made from a wire or rod of wrought-iron or mild steel rolled either hot or cold.

FAN ATTACHMENT FOR SEWING-MACHINES.—M. STEINER, New York, N. Y. The object of this invention is to provide means for fanning the operator, and in attaining this end the inventor provides a peculiarly-constructed fan which is attached to the shaft carrying the fly-wheel of the machine, or to the fly-wheel itself, so that as soon as the machine is operated the fan is turned and a current of air is produced.

CONCENTRATOR.—D. MCL. STOREY, Weeping Water, Neb. The invention refers to concentrators such as shown and described in the application for former Letters Patent, filed by Mr. Storey. The object of the present invention is to provide a concentrator designed for treating materials from stamp-mills or from placers to effectively separate the precious metals from the tailings.

GOVERNOR FOR FEEDERS OF THRESHING-MACHINES.—W. C. PETERSON, Geneva, Neb. The aim of this inventor is to provide an adjustable bundle-carrier so constructed that it can be folded under the feeder when desired and a feed-roller and shield for the same by means of which the amount of grain being fed to the cylinder is regulated and controlled automatically after the amount of pressure required to raise the shield has been determined upon.

CENTRIFUGAL MACHINE.—M. DE MARCHÉVILLE, 44 Rue de Château Landon, Paris, France. In this patent the invention refers to a centrifugal hydro-extractor whereof the basket or drum is in the form of a truncated cone, the bottom being at the larger base, while the smaller base is entirely open and, unlike the usual form, devoid of internal flange, thus permitting the use of an extractor having an alternating rectilinear movement and capable of passing completely out of the drum, which in consequence of its form will retain the material under treatment, notwithstanding the absence of any internal flange.

TREADLE MECHANISM FOR LIGHT MACHINERY.—J. WIEBE, Whitewater, Kan. The object of this improvement is to provide a mechanism more especially designed for use on washing-machines, churns, and other light machinery, the mechanism being arranged to enable the operator to turn the main shaft of the machine to be driven for a considerable length of time without much physical exertion on the part of the operator.

PACKING-MACHINE FOR PLASTIC MATERIALS.—J. C. THOM, Helmetta, N. J. This invention relates to improvements in machines for packing material into jars, bottles, cans, or other receptacles. In packing plastic or damp material—such, for instance, as snuff—considerable difficulty is found in that the material or a portion thereof adheres to the conveyer and retards the packing, and therefore one object of the invention is to provide a novel form of conveyor by means of which the above difficulty is overcome.

ROLLS FOR USE IN THE PRODUCTION OF SHEET-METAL STRIPS.—G. B. JOHNSON, 8 Victoria Street, city of Westminster, London, England. This invention pertains to improvements in the rolls used in a machine for rolling sheet-metal strips to a curved, reversely-curved, or other form in cross-section (for fencing standards, "droopers," and pales, guttering, sash-bars, and the like) for which previous Letters Patent were granted to Mr. Johnson; and the invention has for its object to obviate rubbing friction on the opposite sides of the strips consequent on difference of surface velocity of the rolls of a pair.

TILE-MACHINE.—D. E. FORTON, Evart, Mich. By means of this machine tile may be readily and accurately formed. In operation the parts being assembled, the cement is entered at the top, while the core is rotated. The spiral flange carried by the core forces the material downward, first to the bottom, and filling as cement is supplied, and after forming the main portion of a tile the upper enlarged portion will be formed. The tile is readily removed, or the sections of the outer casing may be separated therefrom, because of the paper lining, which prevents the material sticking to the casing surface.

MUSIC-LEAF TURNER.—P. ENGELKING and F. C. ENGELKING, Peters, Texas. One of the principal objects of this improvement is to construct a music-leaf turner which may be used in connection with any sort of a musical instrument, such as a piano or a violin, and which shall be positive in its operation and shall have the parts so correlated that the music will be turned sheet by sheet.

KINETIC-ENERGY MACHINE.—E. L. N. DENIS, 135 Boulevard Ménilmontant, Paris, France. The invention forming the object of this application for a patent is relative to a system of mechanism acting on the principle of *vis viva*, the movement of which is *desmodromical*, and which is applicable to punches, scales, cutters, hammers, and the like. The invention consists of a mechanism of transmission between a heavy body and a gearing-shaft having a rotary and uniform motion.

WEIGHING AND PACKAGING MACHINE.—T. J. BROUGH, Baltimore, Md. Mr. Brough's invention is an automatic machine adapted for measuring and weighing pulverulent substances or those of allied character, such as tea, coffee, spices, etc. The material being measured and weighed is prevented from being packed, through the operation of means practically self-discharging and at the same time that duly agitate and remove the material from the hopper.

Of Interest to Farmers.

COTTON-STALK PULLER.—C. R. SMITH, Gonzales, Texas. The intention in this instance is to provide a construction by which a powerful pull may be exerted on the stalks for the purpose of extracting the stalks and roots as the machine crosses the field, whereby the stalks may be collected and cremated for the destruction of insect pests, such as the cotton-weevil, and the ground may be prepared without the labor of first plowing to eliminate the cotton-stalk roots.

DISK CULTIVATOR-PLOW.—E. B. LEE and C. H. BEAZLEY, Leesburg, Ga. One of the principal objects of the inventors is the provision of means for overcoming numerous disadvantages found in cultivator-plows of the disk form and also to provide a plow of this character which is simple and comparatively inexpensive to manufacture, as well as easily adjusted, and comprising but few parts not liable to get out of order or become easily broken or dislocated. Soil of any kind may be admirably bedded and otherwise operated upon by the use of the improvements.

CUTTER-BAR FOR MOWING-MACHINES. W. W. JONES, Downs, Kan. The purpose in this case is to so construct a cutter-bar especially adapted for field-machines that the sickle-bar will have a uniform and firm support throughout the length of its travel and in operation will be protected from dust, gum, or any material likely to crowd its action, thereby insuring the least possible amount of friction and enabling both bars to be made lighter and wear longer than usual.

HAY-PRESS.—J. C. DAMRON, Roanoke, Va. Mr. Damron's invention is an improvement in baling-presses especially designed for baling hay, but which may be used for other material when desired. In carrying out the invention he employs a bale-box, together with suitable framing for the press, which bale-box and framing may be in general respects and some exceptions, of ordinary construction.

Pertaining to Vehicles.

STEERING-GEAR FOR MOTOR-VEHICLES.—L. RENAULT, Billancourt, Seine, France. In this instance the invention has reference to steering-gear for motor and other vehicles; and the improved apparatus presents the advantage of realizing a steering almost completely irreversible, very solid, and not wearing away, since the screw works normally without the intervention of a lever-arm. Furthermore, the cylindrical screw permits of employing a nut of very great length and bearing consequently on a large surface.

BALL-BEARING WHEEL-HUB.—B. P. YOUMANS and H. W. RAND, Vancouver, Wash. In this patent the invention has reference to improvements in ball-bearing wheel-hubs for vehicles; and the object the inventors have in view is the provision of a construction adapted to be readily applied to ordinary wooden hubs of any size and style which insures easy running of the hub on the axle-spindle and is thoroughly dust-proof.

Railways and Their Accessories.

SWITCH MECHANISM.—J. W. OSBORNE, Exeter, Ill. In this patent the invention relates to improvements in switch mechanism for railways, the object being to provide a mechanism of this character of simple construction that may be operated in one direction by a device carried by a car and under the control of the motorman or other attendant.

INCLINED RAILWAY.—S. E. JACKMAN, New York, N. Y. The aim in this invention is to provide a switch-back railway arranged to allow two cars to race by their own momentum down adjacent tracks to afford exciting rides for the passengers, especially as it is possible for the car on the outer longer track, loaded heavier than the car on the inner shorter track, to outstrip the car on the shorter or inner track. Mr. Jackman has invented another inclined railway, wherein the object is to provide a switch-back railway arranged for racing two cars by their own momentum down adjacent separate continuous tracks, crossing each other twice above grade and in reverse

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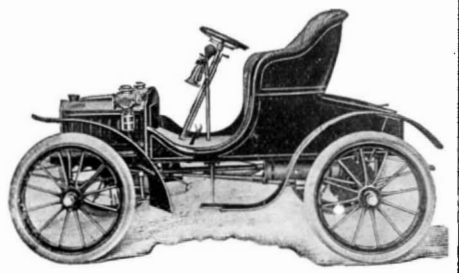

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order, to render the tracks approximately alike in length, in inclination, and at the crossing, to make the chances equal for either car to reach the station first.

CAR-SEAT.—B. REPSDORPH and W. H. BURTON, Houston, Texas. In this patent the invention is an improvement in car-seats, being especially intended to provide a novel construction whereby seats and the backs thereof may be adjusted to form a bed for use when desired. The backs are upholstered alike on both sides, and one back will operate as a pillow for the passenger when the parts are adjusted.

Miscellaneous.

SHOULDER-PAD.—H. LAVINE, New York, N. Y. The invention pertains to improvements in shoulder-pads for coats or like garments, an object being to provide a pad so constructed as to maintain a gradually-increasing thickness from one edge to the other, thus preventing any abrupt depressions in the shoulder portion of a coat or the like in which the pad may be placed.

DISTANCE OR RANGE-FINDING INSTRUMENT.—T. ADAMSON, New York, N. Y. Mr. Adamson's improvements are intended more especially for use upon marine vessels and the like, and the principal object is to provide an instrument of this kind whereby the navigator is enabled to ascertain at any time the distance of the vessel from a given distant point ahead—as a lighthouse, for instance—and also to likewise ascertain the distance the vessel will be from such a point when abreast of the same.

CHART OR PATTERN FOR CROCHET-WORK.—EMILY C. FAUST, Kasson, Minn. In this instance the invention has reference to apparel apparatus; and the inventors object is to provide a new and improved chart or pattern more especially designed for use in crocheting jackets and like garments and arranged to guide the worker in such a manner as to insure the formation of a well-fitting garment.

POCKET DEVELOPING AND FIXING DEVICE.—R. R. LUTZ, San German, Porto Rico. In this patent the invention pertains to a portable developing and fixing device; and one object in view is to furnish a compact construction adapted to be easily carried in the pocket, and to be used in the daylight for developing, washing, and fixing photographic plates without exposing them to the action of injurious light-rays.

JAR-CLOSURE.—C. H. NICHOLSON, New York, N. Y. The object of the improvement is to provide a jar-closure which is simple and durable in construction, cheap to manufacture, and arranged to hermetically seal the jar and preserve the contents thereof against deterioration. To open the jar, an air passage is easily formed through the exposed rubber ring by inserting any sharp instrument under the outer beveled edge of the V-shaped rim of the cover.

PESSARY.—F. L. PRIEST, Dallas, Texas. The invention relates to mechanical means for supporting the womb, relieve menstruation, and provide for drainage in ulceration. The appliance is made so as to avoid abrasion of tissue; it may be conveniently self-applied or removed, and worn without discomfort any length of time, and will afford safe and reliable means for the application of medicaments to diseased parts, or a tampon to check hemorrhage.

MATCH SAFE AND LIGHTER.—C. F. A. CAMMANN, New York, N. Y. The object of the invention is to provide an improved match safe and lighter arranged to permit of conveniently igniting matches without danger of ignited particles or sparks flying into the room and firing curtains and the like and to allow of holding the match in position for convenient each by the user and for immediate ignition, especially in the night.

STEREOSCOPE.—W. F. FOLMER and A. M. LAWRENCE, New York, N. Y. The purpose in the present case is to provide a stereoscope so constructed that a view, no matter of what character, taken with stereoscopic lenses may be placed in the instrument without the object being mechanically reversed, as is customary, and through adjustment of the lenses to optically reverse the object, whereby to obtain proper stereoscopic effect.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

The Current Supplement.

The current SUPPLEMENT, 1465, opens with the first installment of a very exhaustive description of the Edison Portland Cement Works, illustrated by a full set of photographs and diagrams. "Grape, Raisin, and Wine Production in the United States" is the title of a well-illustrated article continued from the last number. The list of grants made by Carnegie Institution is continued. The Paris Automobile Show is made the subject of an article by the Paris correspondent of the SCIENTIFIC AMERICAN, in which he discusses novel details of construction which distinguish some of the vehicles exhibited. The usual Engineering Notes, Trade Suggestions from United States Consuls, and Selected Formulæ will be found in their accustomed places.

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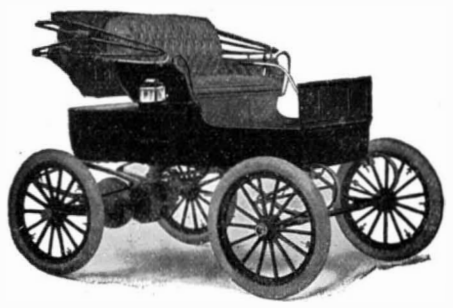

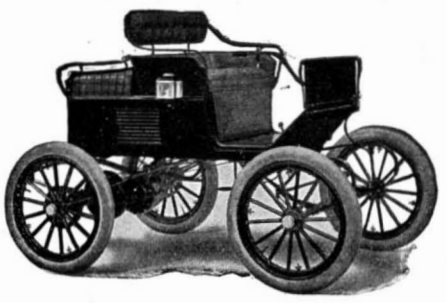

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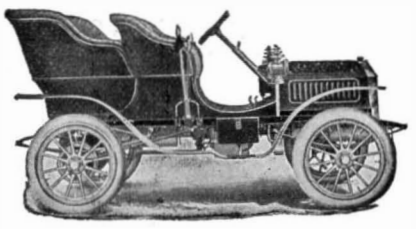

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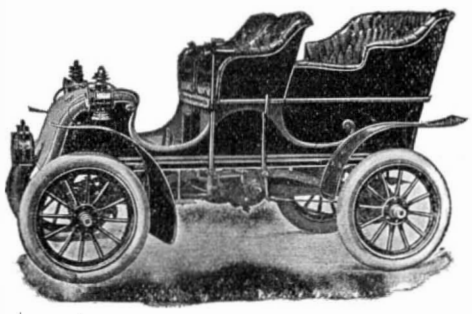

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(9292) S. N. S. asks: Suppose one is using 1 kilowatt of electricity to heat a room; about how many pounds of anthracite coal per hour, burned in an ordinary stove, would it take to produce the same amount of heat? A. The perfect combustion of 0.235 pound carbon will produce 1 kilowatt hour of electrical energy. This is theoretical. No figure of value can be given for "anthracite burned in an ordinary stove" since there are all sorts of coal and all sorts of stoves. Authorities differ, but 16 per cent is a liberal allowance for the heating value of coal burned in an ordinary stove, and this would make the quantity of coal required about 1½ pounds per kilowatt hour.

(9293) E. P. asks: Can you through the columns of your valuable journal give an idea of how to sharpen the points of diamond drills, that is to say, very small drills of about 1-16-inch diameter, and how they are turned up true? We have a great many drills in operation and often one or more get dull and the delay of sending them away will pay the firm to put in apparatus for doing the work, and if I had only an idea of how done would soon experiment. A. For putting a cutting edge on small diamond drills, you will need a small soft steel lap, about five inches diameter, run at about 200 revolutions per minute. The face of the lap to be fed occasionally with a small portion of diamond dust in oil. Use but little oil to prevent waste, hold the drill to the lap lightly, as in grinding on an emery wheel.

(9294) J. S. C. asks: 1. How many pounds of compressed air could be put in a small brass tank 1-16 inch thick, 6 inches long, 3 inches wide, 3 inches high, soldered with silver solder? A. If the tank is strong enough to bear 75 pounds pressure per square inch, you can put in six volumes of air weighing 23-100 of an ounce. 2. What is the formula for determining the amount of pounds? A. Thirteen cubic feet of air weighs 1 pound. The capacity of the box is 54 cubic inches or 1-32 of a cubic foot × 6 volumes = 6-32 cubic foot ÷ 13 = 6-416 × 16 ounces = 6-26 ounce or 0.23 of an ounce. 3. If I should put a safety valve on the above tank what would have to be the length of the lever, how far from the end would fulcrum have to be placed, how far from the fulcrum would weight have to be placed, and what should be the weight? Give formula. A. The size of safety valve need be no more than ⅝ inch diameter made by the formula:

$$P = \frac{W1 + wg + V1}{A1}$$ in which

P = air pressure per square inch.
W = weight of ball.
w = weight of lever.
g = distance between fulcrum and ball.
V = weight of valve and spindle.
1 = distance between valve center and fulcrum.
A = area of valve.
All in inches.

(9295) M. N. H. asks: Would thank you to let me know if there is any substance ⅛ inch thick or thinner that will insulate the power of a magnet: in other words, is there anything against which magnets can be placed that will prevent the magnets from being attracted toward each other if you would place a magnet on each side of a thin sheet of same? Any information you can give me on the subject will be very thankfully received. A. There is no substance which can prevent two magnets from attracting each other when placed between the two magnets. Iron is the only screen for magnetism and that because it offers an easier path for magnetism than air offers. If two magnets were placed on opposite sides of a plate of iron each would convert the iron into a magnet and both would adhere firmly to it. This is not what we understand you to be in search of.

(9296) J. W. K. asks: 1. What causes the phenomena known as Fata Morgana? A. The Fata Morgana is the name by which the mirage was known. It is an optical illusion produced by unequal heating of the air near the surface of the earth and above it. The rays of light are bent by refraction, so that the angle of refraction finally becomes larger than the critical angle and the light is totally

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reflected, changing its direction so as to make it enter the eye as if coming from a very different direction from the real direction of the object. Many textbooks of physics give illustrations of this. You can find it in Ganot, which we can send you for $5. 2. What causes the Aurora Borealis? A. It is generally accepted by scientific men that the aurora is due to the passage of electric currents through the upper air, where the density of the air is about the same as in a Geissler tube. 3. What caused the dark day on May 19, 1780 A. We do not know what caused the dark day, but believe that it was no different from the days now when it is necessary to light lamps at midday. The cause of the dark days at present is dust in the upper air. The use of soft coal produces this in some places, forest fires in others, and volcanoes in others.

(9297) J. S. P. says: A glue factory and brewery are located within one hundred yards of each other. The glue factory manufactures a first-class, almost odorless, glue from beef hide stock carefully prepared and purified in quicklime water. The vapor generated during the boiling process passes out through openings in the roof of the glue factory as high as the brewery. Is it probable that the odor from the manufacture of glue would in any way affect the quality of the beer made in the said brewery? Would the odor above referred to have a tendency to cause the beer made in the above-mentioned brewery to become what is known as "ropy beer"? A. At the distance of one hundred yards and height of the ventilators of the glue-boiling vats, in a calm, or the wind blowing the vapors away from the brewery, there should be no odor from the glue factory, and no harm done to the beer in any condition of its manufacture. The only possible harm may come with a strong wind blowing from the glue factory directly across the brewery, bringing a strong odor to the mash or mixing tubs, in which case there is probably an absorption of the odor by the cold liquids, but not by hot liquids, as the vapor discharged while the liquids are warm or boiling repels the odor. In the fermenting cellars, the carbonic acid gas being heavy and lying on the top of the beer, should repel any odor that might reach the cellars, and prevent its absorption by the beer. In drawing off the cold beer, there is a possibility of its absorbing the glue odor when very strong to a slight extent, but we think not enough to affect the taste or natural odor of the beer. Still, we think for sanitary reasons that glue factories and breweries should not be near neighbors, for odors are odious.

(9298) W. S. G. asks: 1. Is there any difference between a square foot and a foot square? A. There is no difference between a square foot and a foot square, if the square foot is a foot square; nor is there any difference in the measure of surface, if the square foot is of any other shape than a foot square. So that the term *foot square* is not proper for any surface of a square foot that is not a rectangle of 12 inches on each of its four sides. 2. Is a square foot and a cubic foot the same? A. A cubic foot may be a foot square on each of its six rectangular faces, or it may mean the volume of any form equal to a cubic foot of 1,728 cubic inches.

(9299) G. A. B. asks: Exactly how is the temperature of liquid air measured? How is the displacement of vessels calculated? A. The temperature of liquid air and other low temperature is measured by either a hydrogen thermometer or by a platinum resistance thermometer. The hydrogen thermometer employs the expansion and contraction of that gas as a measure of temperature. The platinum resistance thermometer employs a coil of platinum and a Wheatstone's bridge. The resistance of the platinum coil is determined with accuracy at many points along the scale of temperature, and by means of a curve its resistance can be plotted so as to be an indicator of the temperature corresponding to any resistance. This is explained in Sloane's "Liquid Air," which we can s nd you for $2.50 postpaid.

(9300) A. J. P. asks: 1. Miller's "American Telephone Practice," page 299, says: "The high retardation of the ringer magnets is obtained by winding them to a high resistance with a *comparatively coarse wire,* so as to obtain a large number of turns in the winding." Is not "comparatively coarse wire" meant for fine wire? High resistance would be obtained with fine wire, and not with a coarse one. If he uses a coarse wire, he will not be able to obtain a large number of turns without increasing excessively the size of the coils, and therefore not obtain the result looked for. A. There seems to be no reason to suppose that Miller, in the paragraph referred to, failed to say what he meant. The "comparatively coarse wire" is really a fine wire after all. In the example given, the coarse wire is No. 33 single magnet wire, as against No. 38 used by other makers. The use of the coarser No. 33 allows many more turns with the same resistance, and so a much greater retardation by self-induction, not by ohmic resistance, as you seem to suppose. In the same paragraph, Miller says, "Resistance in itself is not the thing desired, but a great number of turns in the winding." Resistance is the incidental result, but the effect desired is not produced by the resistance. 2. I understand that the ocean cables are operated with a very small current compared to the current used on the telegraph lines. Is this due to the induction, static or magnetic? And what law applies to it? Please give the formula to determine it, if it is, as I understand, due to the induction, the waves getting bigger as the distance increases. Is it right that if a strong current was used on a cable, the distance being great, say from Europe to America, the induction produced in the conductors of the cable would be so great as to destroy the current before it had reached the end of the cable, and would cause a retrograde current to flow back to the starting point. A. An ocean cable is a Leyden jar. Its static capacity is great. No signal can be received at its remote end till the charge sent in has risen sufficiently to work the instruments. This requires an appreciable time. A second signal cannot be sent till the cable has discharged and been recharged as before. This demands that very sensitive apparatus be used. A very good presentation of this may be found in Thompson's "Elementary Lessons," which we can send you for $1.50.

(9301) G. H. G. asks: 1. Is the typhoid germ an animal or vegetable organism? A. The germ of typhoid fever is a vegetable, as are the germs of all such diseases. All bacteria or bacilli are plants, and not animals. 2. In their course around the sun, the planets Venus and Mercury keep the same side to the sun all the time. Is this because they are so near to the sun that its attraction is so great as to prevent a daily axial revolution? And would our moon, if it were far enough away from the earth, have a similar axial revolution as our earth has? A. If the planets Mercury and Venus keep the same face toward the sun, it is because the strong attractive force of the sun in early times, when planets were soft and plastic, raised tides upon them of such size that these tides reduced the velocity of rotation of the planets, and brought them to rest with reference to the central body. This is George Darwin's theory of tidal evolutions, as it is called, which may be found in all modern textbooks of astronomy. It is used to account for the similar motion of our moon. 3. Is the planet Neptune visible to the naked eye at any time? A. The planet Neptune is not visible to the naked eye.

(9302) J. M. D. asks: 1. When two persons are conversing over the line, and a third party takes down his receiver to listen, is there any instrument or some other way of finding out at what instrument the receiver was taken down? If so, what arrangements would have to be made to do so? A. We do not know of any way of telling when a person has "sneaked in" on a telephone circuit already in use for the purpose of listening to what is being said. One of the systems of "selective signaling" would enable one to call a particular telephone on a line having only a limited number of instruments. You can obtain information regarding these by writing to the dealers who supply you with the outfits for your lines. 2. What kind of an instrument is best to use to find out a fault on a line, for instance a broken wire, or where it might be grounded or the line wires tangled, to designate the place where the trouble is without going over the whole line? A. Faults and grounds are located by capacity and other tests, which require galvanometers, condensers, and testing instruments. You will find the processes described with the necessary formulas in Miller's "Telephone Practice," which we can send you for $3. 3. For crossing or bridging the line wires so as to stop the noise on a line, as the line may be quiet on one place, and a few poles further off it may be very noisy, should the wires be bridged where the line is quiet, or on the poles where there is most noise? We have two wires, on cross-arms 30 inches long, and about 10 miles long. How often should the wires be bridged? A. The prevention of inductive disturbances upon a telephone line is secured by crossing the wires over and under at regular intervals, so that the wires in effect are twisted slowly around each other throughout the whole length of the line. The long-distance lines are thus transported at intervals of a quarter mile, in a systematic manner which is shown by a diagram in the book referred to above. 4. How can you find out when the dry batteries need repairing? A. A dry cell needs renewing when its voltage falls below one volt. The only way in which this can be measured is by some one of the battery tested, unless you have a good voltmeter, which is the best instrument to use for such purpose.

(9303) F. F. H. asks. Would you kindly inform me on the following questions: In what position must the carbons of an arc lamp be so as to give the greatest amount of light? How much light will be emitted when the carbons are at an angle of 90 deg., and in which direction will the light be thrown? A. If an arc lamp is to be used in lighting the space below and all around the lamp, as in the street, it is best to place the positive carbon directly above the negative, the centers of the carbons in the same vertical line. If, however, the light is to be projected in some particular direction, it is better to point the positive carbon in the desired direction while the negative carbon stands at an angle with the positive carbon, so as not to cut off any of the light from the positive carbon. They may stand at an angle of even 90 deg. The light will then be projected nearly in the direction of the positive carbon, and nearly all the light will be available. This arrangement is frequently adopted in the stereopticon, where the light is only wanted in the direction of the screen.

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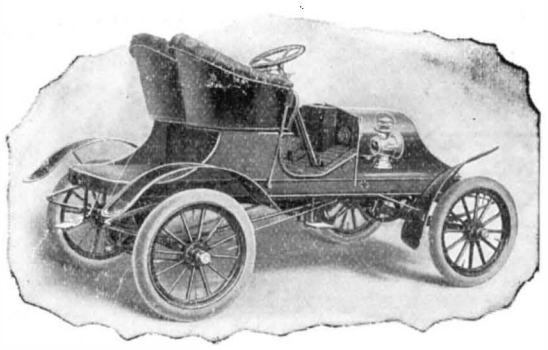

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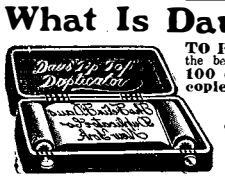

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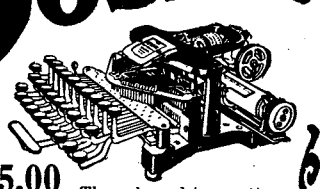

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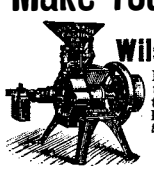

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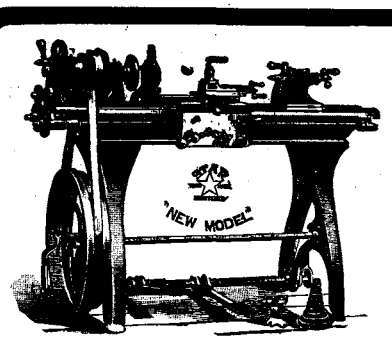
Science Notes.

Benzine is often adulterated with petroleum oil, in which case it gives off a disagreeable and persistent odor. A method of recognizing the fraud consists in placing a small piece of pitch in the suspected benzine, which, when the benzine is adulterated, will soon be dissolved, but will color the liquid less on account of the presence of the petroleum oil. To judge with certainty, it is well to examine the benzine by comparison with a type of standard purity (benzol). Benzine can be distinguished from benzol in the following way: Benzine is colored violet by a crystal of potassium iodide, while benzol is colored carmine. If to two cubic centimeters of benzine three or four drops of a clear ether solution of sandarac (1 to 10) are added, a persistent cloudiness is produced in the benzine, while with benzol, treated in the same way, the cloudiness will soon pass away. Finally, if the benzol is shaken with a drop of alcohol, it will become clouded, while the benzine will remain clear. To deprive the benzine of its characteristic odor, it is sufficient to let it fall drop by drop into a vessel containing sulphuric acid, which is fitted with an abducent tube carrying the benzine in the form of vapor to a receiver, in which it is condensed as a liquid having the odor of honey. The temperature of the mixture of sulphuric acid and benzine ought to be carried to about 150 deg.

Prof. Henri Dufour has drawn up a comparison between the reports of four European meteorological stations—Lausanne, in Switzerland; Heidelberg and Freiburg; and Valencia, in Spain—upon the summer weather of 1903. Their data, taken independently, agree at all points. The sun's warmth from December, 1902, to July and the first half of August, 1903, has undoubtedly been terribly below the average; but some consolation is supplied by the forecasts of Prof. Dufour, with which the Lausanne meteorologist, E. Bahrer, also agrees, that signs are exhibited of a return of normal weather. The cold and the rains of the last summer were not the product of any decline in the power of the sun, as some have fearfully conjectured. "There is no symptom whatever," says the professor, "of any universal cosmic change; the increase of cold or wet is a temporary accident. We have been affected by a phenomenon which is demonstrably partial and limited in time and space."

The principal results of a discussion in the Annals of Harvard College Observatory (vol. xviii., No. 5) are summarized below. The logarithm of the number of stars brighter than a given magnitude is equal to a constant multiplied by the magnitude plus a second constant. On theoretical grounds we should expect that on any reasonable hypothesis the value of the first constant would be 0.60. Its actual value for bright stars is about 0.52, gradually diminishing to 0.46 for stars of the eighth magnitude, and to 0.35 for stars of the twelfth magnitude. An absorbing medium in space, although probable on other grounds, still requires a coefficient of 0.60 for bright stars, and does not account for the observed values. The coefficient is the same in and out of the Milky Way. Accordingly, the distribution of stars in both these regions is identical, or the proportion of stars of any given magnitude is the same. The number of stars for a given area in the Milky Way is about twice as great as in other regions, and this ratio does not increase for faint stars down to the twelfth magnitude. The Milky Way covers about a third of the sky and contains about half of the stars. There is no evidence of a limit to the faintness of stars, although the proportionate increase in number becomes less for each successive magnitude.

A solid fat has been obtained from cocoanut for some years, which has been used in the most varied manner in the



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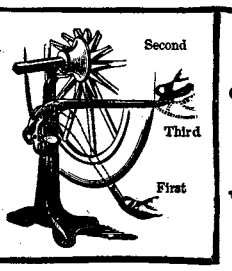

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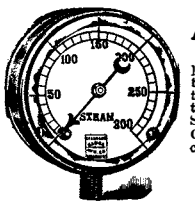

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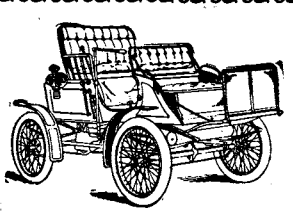

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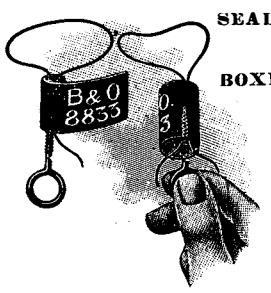

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preparation of foods. This fat is being expressed in large amounts, especially in Marseilles, where it is placed on the market under the name of "Vegetaline," while in Germany it has become known for kitchen use under the name of "Palmin." Recently a French firm has undertaken to produce this fat at the place where the nuts are grown, in India, and has placed its product on the market under the name of "Cocotine." This is a pale-yellow, fluid fat that assumes the consistency of butter when put into cold water, and is both tasteless and odorless. Cocotine has the advantage of not becoming rancid and of not losing its fresh and mild taste for months even if exposed to the air. The production of this fat in Marseilles amounts to six hundred barrels monthly. It could be employed as substitute for lard and for petrolatum in pharmaceutical practice. A vegetable fat called "nucoline" is very similar to cocotine.—Pharmaceutische Centralhalle.

Dr. Ramsden, of the Royal Society of Great Britain, has been carrying out a series of experiments in connection with the surface tension of liquids. If a vessel containing water be closely examined, a thin skin or membrane will be observed floating upon the surface. Although apparently substantial, the skin cannot be detached from the water. In the case of sticky liquids, however, by skillful manipulation this membrane can be detached, which action demonstrates the fact that the skin has a separate existence, and is not, as it were, an inherent part of the liquid. In the course of his experiments, Dr. Ramsden placed a number of candle ends in a vessel of water. They were observed to assume a position of symmetry without any extraneous assistance. When, however, the candles were inserted in a liquid which was slightly sticky, they remained in exactly the same positions in which they were placed, proving the existence of some opposing force which prevented the candle ends from adjusting themselves. This force was clearly the surface membrane on the liquid. Dr. Ramsden's next experiment was still further interesting. He blew a number of bubbles in the liquid, and then deflated them by suction. The bubbles, however, did not entirely disappear, but left behind them secondary bubbles, the extraordinary point of which was that they were not spherical or oviform in shape, but assumed the form of inverted cones. Such formation is impossible without the assistance of a solid. Dr. Ramsden pointed out the fact that on the surfaces of all limpid solutions, which can produce bubbles, there is this thin albeit solid skin, and he demonstrated by mechanical effort that it is possible to heap these membranes together in such a manner as to cause them to form opaque solid masses. These masses can be separated from solutions of one in one million parts.

Radium has still another curiosity to number among its remarkable phenomena. In the Electrician it is chronicled that Mr. E. Dorn inclosed 30 milligrammes of Buchler's strongest radium bromide in a tube of Jena glass free from alkali and 6 centimeters long. This was done last December. At the end of May he wanted to open the tube. Just as he was applying a three-cornered file, and had only slightly scratched the surface, the glass was pierced by an electric spark with an audible noise. The phenomenon may be explained by supposing that the negative electrons had escaped through the walls of the tube, which were 0.3 millimeter thick, and a positive charge remained. Negative ions would then accumulate on the outer surface of the tube, and this accumulation would be facilitated by the ionization of the air around. Since the author held the tube in his left hand and the file in his right, the discharge was rendered possible. But it is remarkable that a difference of potential capable of puncturing at least 0.2 millimeter of glass should have been produced.

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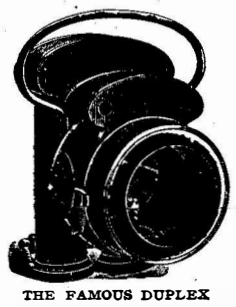

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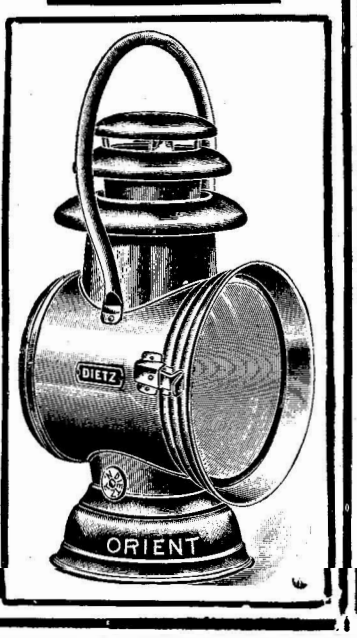

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After certain tests of abrasive wheels made at Sibley College, the metal removed was micro-photographed. The photographs, it is said, show that the metal removed by emery wheels is in the form of minute globules; that from carborundum wheels is in the shape of chips or shavings. This seems to show that an emery wheel "grinds" or wears the metal off, while the carborundum wheel cuts it off in a manner much the same as a milling cutter. This is an important distinction. It not only indicates that the carborundum wheel should be the most efficient in metal removed for the same power, but that heating should be much less, since it is cut off instead of being abraded by friction. The wheel that heats the least, other things being equal, should give the most accurate work.

According to careful experiments made by Prof. S. P. Thompson, a square foot of uncovered steam-pipe filled with the vapor of 100-pound pressure will radiate and dissipate in a year the heat put into 3,716 pounds of steam by the economic combustion of 398 pounds of average coal. Thus, 10 square feet of bare pipe corresponds approximately to the waste of two tons of coal per annum. Another experimenter, testing the various materials employed for wrapping, concludes that the saving in condensation effected with the best form of mica covering is nearly 88 per cent—that is, calling the loss of heat with bare pipes 100, the loss when wrapped with mica-packing would be 12. Asbestos covering seems to be considerably inferior to mica, and cements less desirable than either.

Some twelve months ago a motor schooner, the "Sirra," was constructed at Rotterdam, with the propelling engine consisting of a 50-horsepower gasoline motor. The vessel was constructed as an experiment to ascertain the feasibility of adapting this class of engine to small vessels. The craft has only been employed during this period for coasting purposes, but it recently completed with conspicuous success its first sea voyage from St. Petersburg to Dundee, Scotland, with a freight of oilcake. The "Sirra" is the first gasoline-motor-propelled vessel to undertake a sea voyage. The most prominent features of this type of craft are the small space occupied by the machinery, the absence of coal bunkers, which consequently renders greater space available for freight, and a clearer atmosphere on board. During the twelve months no mishap or breakdown, except of a temporary minor character, has been encountered, so that new possibilities appear to be available for the gasoline engine.

The engineers of both the elevated and subway lines in operation or in the course of construction are very much concerned about the matter of the noise made by the moving trains. No end of experiments have been made with a view of suppressing the din, but with very little success. The latest suggestion to be tried with this object in view has been that of ballasting an elevated structure with broken stone, much the same as the more important surface lines have been treated, in the effort to secure a perfect roadbed. For a stretch of about three train lengths on the circuit between Rowe's Wharf and Congress Street, Boston, the sleepers have been boarded up from the under side, and the rails raised about four inches, and the spaces filled to the level of the tracks with rock ballast. It is the first time in the history of railroading that the well-known principle of rock-ballasting has been applied to an elevated structure. The stone has not been in place long enough to warrant any decision, but on account of the great expense which would be entailed by its general adoption, the whole line will not be so treated unless its advantages are shown to be very great.

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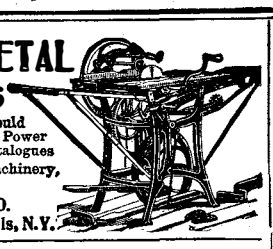

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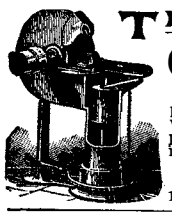

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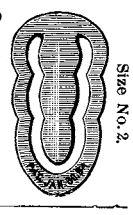

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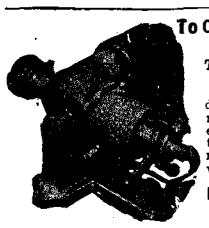

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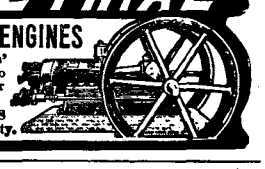

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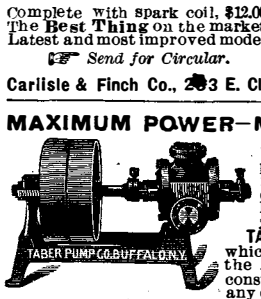

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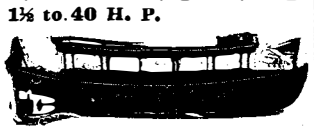

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type, rated at 5,500 to 8,280 kilowatts, occupy a space measuring only 51¾ feet by 14 feet by 12 feet. A 6,500-kilowatt turbo-generating set is being built by Brown, Boveri & Co., which measures 59 feet by 10 feet by 10 feet. A Curtis turbine of 5,000 kilowatts is running in Chicago; this is a combination of the Parsons and De Laval systems, and is arranged with a vertical shaft. In shape it is cylindrical, and, including turbine and generator, stands 25 feet high with a diameter of 14 feet. It may be interesting to note that there are over 500,000 horsepower of turbines in use or on order, and twenty-four stations in this country use the turbine more or less.

It is known that when a cylindrical rod is struck by an approximately axial blow, the particles of the rod perform in general elliptic vibrations, the axes of which vary in direction at different points, and it was one of the objects of a study reported in the Abhandlungen of the Bavarian Academy to find how far a gun-barrel behaved in the same manner. A number of military Mauser rifles were furnished with projecting wires, and the motions of their shadows, thrown on a screen by a lens, were photographically recorded side by side with a tuning-fork trace. It was thus found that the vibrations are in general of an elliptic character, and consist of a fundamental and overtones. The periods of vibration of the prime and first two overtones are of the order 0.04, 0.008, and 0.002 of a second. It was arranged that the instant of the bullet leaving the muzzle should be shown by a white dot on the photograph. The diagrams given show that in one case (that for a 6-millimeter Mauser rifle) the bullet is clear of the barrel before any deflection due to vibration has occurred. This is obviously an important practical result.

The Paris Municipal Committee, appointed to investigate the recent tunnel disaster on the Metropolitan Railroad, has made its report, indicating the reforms which should be immediately made in the underground railroad system of Paris. The principal proposals are that the present system of a motor car at each end of the train should be suppressed; the motor cars must be capable of isolation from the train; in case of the slightest fire, the train must be stopped and the motor cars isolated; telephones and speaking tubes must be provided at reasonable intervals along the line; the number of employes at the stations must be increased; the platforms must be cleared of every obstruction and lighted by an electric current, independent of the currents supplying the traction or the lighting of the tunnels; and numerous lamps must be placed to indicate the direction of the exit. The report states that it is proposed to insist that later on incombustible rolling stock be used and that refuges be constructed in the tunnel walls.

With the bad waters in the Southwest and under the necessity of providing engines enough for the trains, an effort is being made to extend the life of firebox sheets by removing in every possible way all unnecessary thicknesses of metal between the fire and the water. In this connection crown bolts with large heads are giving place to crown stays resembling stay bolts having taper threads in the crown sheet and riveted over like stay bolts. On a number of roads opinion favors wider mud rings with 5-inch water spaces at the bottom of the water leg. There is also a tendency toward widening the spaces between tubes, making 1-inch bridges instead of the narrower spaces now prevalent. Several roads are now experimenting in this direction. They are prepared to sacrifice some tube heating surface for the sake of securing more water space around each tube in the hope of reducing the amount of tube leakage.

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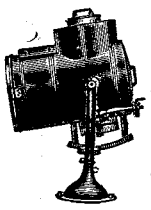

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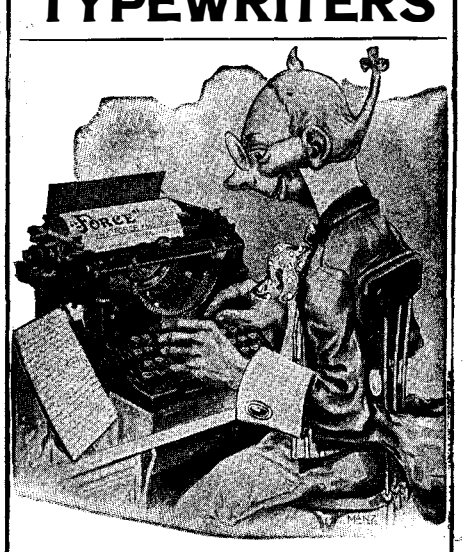

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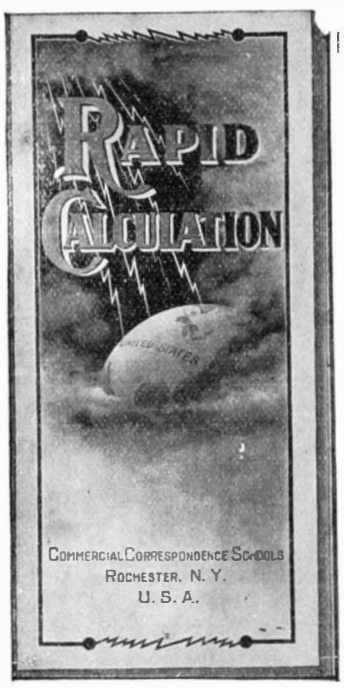

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SOME 1904 TOURING CARS.

(*Continued from page* 79.)

of being cast in pairs, as are the cylinders of the 35-horsepower motor. This is the only radical difference between the two cars. The jump spark method of ignition only is employed in the smaller motor, and there are a number of changes and modifications in details. The wheel base of the car is 92 inches; the wheels are 34 inches in diameter, fitted with 4-inch double-tube tires. The transmission mechanism is designed for three forward speeds and a reverse.

The two models may be equipped with different styles of bodies, and several options in finishes and upholstering are offered.

The Elmore Manufacturing Company, of Clyde, Ohio, was one of the first firms, and is, we believe, still the only one, building automobiles with a two-cycle motor.

The 1904 type of motor is a single-cylinder, horizontal motor, of 7 horse power. Its normal speed is 800 R. P. M., and the bore and stroke are 4½ and 4 inches respectively. The motor is now lubricated by a pressure feed oiler that shuts off automatically when the engine stops. The two large oil cups for supplying oil to the cylinder and crank case, and the grease cups for the shaft bearings are no longer employed. The carbureter is attached to a pipe on one end of the crank case, and the spark plug can be seen projecting through the wall of the cylinder head. The transfer passage from the crank case to the cylinder is on top of the motor, and is fitted with a cover held down by six bolts. The exhaust pipe is seen below the motor, and the two water pipes are seen in the head and side of the cylinder jacket respectively. A pet cock in the cylinder head is used to determine whether the motor is firing.

The carbureter used with the Elmore motor has been specially designed for this type of engine, and is said to give a constant and unvarying mixture at all speeds. The air enters through holes near the bottom, and is drawn up past the spraying nozzle in such a way as to increase the suction in direct proportion to the speed of the motor. An auxiliary air-throttle is fitted, besides the regular throttle in the inlet pipe, with the result that the suction is practically the same, whether the motor is throttled or not. This makes it possible to run the motor at very slow speeds, and yet have it develop a reasonable amount of power.

The photograph of the tonneau car shows at a glance the method of hanging the motor upon two brackets beneath the side bars of the frame. On the other side of the motor there is a planetary gear transmission, giving two speeds and a reverse, and furnishing a direct drive to the rear axle on the high speed. The single lever shown at the side controls the speed change mechanism. The gasoline tank is seen under the seat, and the batteries and spark coil are in a box beneath the floor. The car is fitted with two brakes, one on the transmission gear, and the other acting on a double drum on the rear axle. Radiating coils are fitted at the front of the car, and the water is circulated by a positively-driven pump. The water tank is placed partially in the box in front. Roller bearings are used on the rear axle, and ball bearings on the front wheels. Three-inch tires of the detachable type are used on the 28-inch wheels, while the wheel base of the car is 70 inches, and the tread standard. Besides the tonneau machine shown, the company makes two other runabout models fitted with twin cylinder, vertical motors, and a three-speed planetary gear transmission. All three of these models are capable of 25 miles an hour.

The two-cylinder Royal tourist has a 16-horsepower vertical motor, which runs at a maximum speed of 1,300 R. P. M., and is capable of being throttled down as low as 250. The crank case is made of aluminium in order to reduce weight and add strength, and aluminium castings are used throughout wherever practicable. The inlet valves work automatically, and are accessible by simply removing three nuts and loosening a universal joint on the inlet pipe. The governor acts upon the throttle, and makes the action of the motor very flexible under all conditions. An improved cone clutch is used, with a universal connection between it and the change-gear case. The latter is of the three-speed and reverse, sliding gear type. It is inclosed in a dust-proof, oil-tight, aluminium crank case, with direct drive on the high speed through a driving shaft having two universal joints, to the bevel-gear drive on the rear axle. The rear axle is of very rigid construction, with roller bearings throughout and with a truss rod underneath. Both pedal-operated transmission and hand-operated wheel-hub brakes are fitted. It is impossible to change the speed gears without throwing out the clutch. The front wheels have roller bearings, with forward steering gear connection, operated by a very substantial steering gear of the wheel type. The frame is of the pressed-steel type, made from polished cold-rolled stock. It is mounted on very long 2-inch springs, forward and rear, that will insure easy and comfortable riding under all conditions. The wheels are equipped with 3½ by 34-inch heavy, detachable tires. The wheel base is 90 inches; the tread 56 inches. The spark regulator and throttle control are operated at the wheel, while the spark coils and forced-feed oiler are placed on the dash, within easy reach of the operator. The oiling device gives a positive feed to the motor, and all principal bearings of same, as well as the transmission gear. The latest type of cellular radiator with fan attachment is used, thus doing away with the auxiliary tank and unnecessary piping. The gasoline tank holds 15 gallons, and is located under the front seat of the body.

The body is a modified form of the "King of the Belgians" type, and is made entirely of aluminium. An oval, top-hinged hood of the latest type makes the motor at every point easy of access, and gives the car a long and very smart appearance. The complete car weighs less than 1,750 pounds, and is capable of speeds up to 40 miles an hour. It has a full equipment of gas and oil lamps, long-tube horn, and a full set of tools. A canopy top and side baskets will be furnished extra if desired.

The four-cylinder model develops 32 horse power, and, in detail of construction of the chassis, is an exact duplicate of the two-cylinder model, with the exception that two of the double-cylinder motors are placed side by side, with an extended aluminium crank case. The other parts of the chassis, including the transmission and axles, are constructed so that they may be used for the two or four-cylinder car. The latter machine weighs 2,000 pounds, and is capable of speeds up to 50 miles an hour.

The principal improvements in the mechanism of the 1904 Winton touring car are minor ones. Chief among them are improved clutches consisting of a beveled steel plate that presses into a similarly-beveled, hollowed-out portion of the bronze gear, and that is said to always hold, although it runs in oil; and a new pressure-feed oiling device with a small tank below the motor, from which the oil is pumped up by a cam-driven plunger pump, and flowed over all the bearings of the motor and transmission. The crank shaft has been enlarged, as well as several other parts which it was deemed prudent to strengthen somewhat. The addition of a handsome canopy top has done much to make the Winton a very attractive car, besides making it a thoroughly serviceable one in all kinds of weather.

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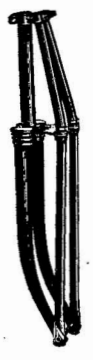

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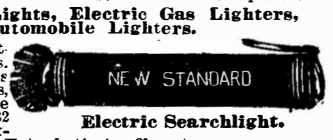

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liness, the Woods Motor Vehicle Company, of Chicago, has brought out, as one of its latest models, an electric tonneau car of five electrical horse power. This has the superficial characteristics of the gasoline tonneau car, including the front bonnet and wheel steering, but in this case the bonnet covers half of the battery cells, and the motors are suspended below and in front of the rear axle, the armature pinions driving direct to external spur wheels bolted to the drive wheels. The remaining twenty cells of the forty-cell battery are under the front seat. The battery is of 160 ampere-hour capacity and is expected to drive the car 60 miles on one charge over asphalt or good macadam streets. The motors, of which there are two, are of 2½ horse power each. The controller gives four forward speeds (5, 10, 14, and 18 miles an hour) and one reverse. There are two brakes, one operated by the foot and the other by the controller hand lever.

The body, the tonneau portion of which is removable, is mounted on a Woods running gear extended to an 88-inch wheel base and fitted with 32-inch front and 36-inch rear wheels of artillery type. The wheels have steel hubs and are equipped with 2½-inch solid rubber tires. The tread is 56 inches. The seating capacity is four passengers and the operator, and the weight complete is 3,200 pounds.

Other new models offered by the Woods Company are the "Queen Victoria," an extension-front brougham, and an inside-operated brougham or physician's coupe. The distinguishing new features of these are the dividing of the battery so that half of the cells are carried over the front axle and the rest over the rear axle, thereby distributing the weight more evenly on the running gear, and the use of downwardly-curved horns at the front of the vehicle to connect with the springs.

Electrical Notes.

A new surface-contact system of electric traction as applied to railways was put on trial recently in America on a mile of experimental line on the Pennsylvania Railroad. Report states that a speed of 85 miles an hour was attained, and that in other respects the results were successful.

On the subject of paper insulation the American Steel and Wire Company has made extensive tests with paper-insulated wire and cables with results that are considered very important. As a consequence of these tests this paper insulation has been adopted for the New York underground system.

At the exhibition of motor cars in Paris the Ducommun 24-horsepower car has a motor fitted with automatic induction valves made in one piece, the valve ring and guide being formed in halves so fashioned that upon the valve and its seating being withdrawn from the valve-box the valve itself can be detached and quickly replaced.

The authorities in charge of the telephone service in Japan have decided to employ only girls, both for day and night duty, at the various exchanges. Men were formerly employed for night work, but this arrangement proved unsatisfactory. This branch of the service gives employment to 3,017 hands, of which number 1,129 are girls.

The total energy generated and used at the St. Louis Exhibition will be close upon 50,000 horse power. Over 80 per cent of the electric energy will be in 6,600-volt, three-phase, 25-cycle current. The largest unit will be an 8,000-horsepower steam turbine, and the next largest a 5,000-horsepower compound horizontal and vertical reciprocating steam engine.

At Baku, on the north side of the Caspian Sea, an electric power station has been erected for supplying power to the oil wells in that locality. There are 2,000 oil wells, scattered among a number of villages. These produced last year about 11,000,000 tons of oil. The central station has an output of 1,500 horse power, and is located near the shore of the sea, so that the water might be used for condensing. There are four tubular boilers, using as a combustible the waste product from the oil refineries. The station contains two 750-horsepower engines, having each three cylinders, and each driving a three-phase alternator which generates 6,500 volts at 100 cycles per second. Each alternator has its own switchboard. The transmission line extends eleven kilometers from Baku. At sub-stations the voltage is lowered by transformers to 1,100 and supplied to the motors, which have an output of between thirty and fifty horse power. This type of plant was adopted to diminish as much as possible all fire risks arising from the character of the work.—L'Electricien.

In 1885 the Vienna conference decided to use a tuning fork upon a sounding board, and actuated by an electromagnet, in order to obtain a longer period. At the time, attention was called to the fact that the magnetic field might change the pitch of the fork, and some attempts were made by various investigators to detect such an effect. Herr O. Kirstein has made a careful study of this matter, and by using two forks in tune when vibrating freely, he found that they were no longer in tune if one of the forks was actuated by an electromagnet. By selecting two forks not exactly in tune, and observing the beats, and then by changing the period of either one, he was able to determine the effect of the magnetic field. The following are his conclusions: If a tuning fork vibrates in a magnetic field in such a way that the lines of force are perpendicular to the plane of vibration, the pitch of the fork is raised. On the other hand, if the lines of force are parallel to the plane of vibration, the pitch is lowered. The change in pitch is directly proportional to the field strength. The effect of the magnetic field is only temporary. For a given field strength the decrease in the pitch is greater than the increase. If the plane of vibration of the fork lies at forty-five degrees to the lines of force, there is no change in the pitch.—Physikalische Zeitschrift.

A remarkable feat was achieved with the electrophone on the occasion of the British Prime Minister's recent speech at Sheffield. At the London premises of the Electrophone Company in Gerrard Street, receiving instruments were connected to the telephone wires provided by the National Telephone Company, which extended to the latter's switchboard, and there were connected to the Post Office trunk cable between London and Glasgow. This line was tapped at Sheffield, and at the building in which the speech was delivered six especially powerful transmitters were fitted at a distance of four feet from the speaker. At the London end of the wire the auditors, composed mostly of journalists, were provided with a double receiver, which was held against the ear. The distance between London and Sheffield is 220 miles, but so successful was the experiment, that notwithstanding the enormous distance, every word and sound in the building in which the speech was delivered were heard with such conspicuous clearness, that it sounded as if the speaker were in the receiving room. Not an inflection in his voice was lost, and even the pushing back of his chair as he rose to leave the platform was distinctly heard. One or two leader writers of the London papers actually penned their articles, while listening to the speech for the following morning's papers, which affords a very comprehensive idea of the success of the experiment. This is the first attempt to utilize the electrophone over such a great distance and it opens new possibilities for this instrument, since it is contended that there is no finality to the employment of the electrophone, success depending upon the utilization of sufficiently powerful transmitters.

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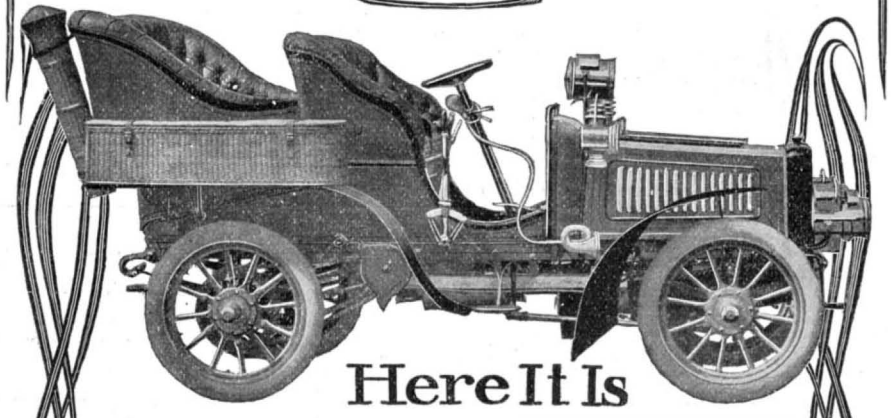

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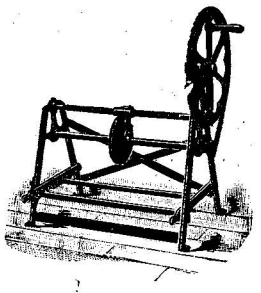

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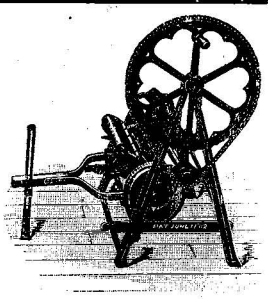

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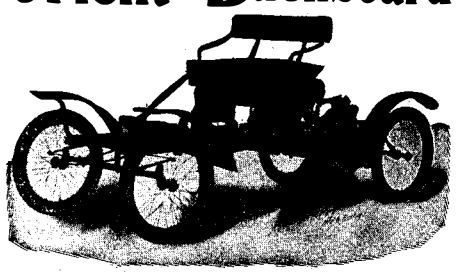

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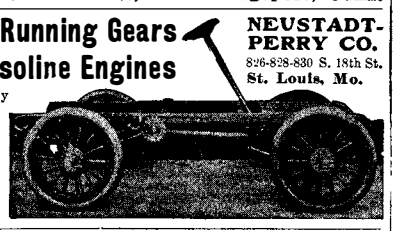

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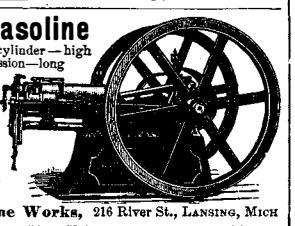

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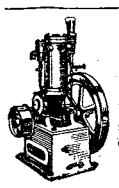

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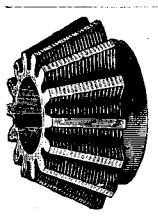

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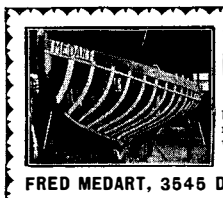

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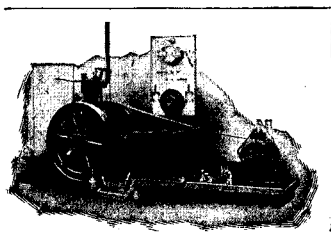

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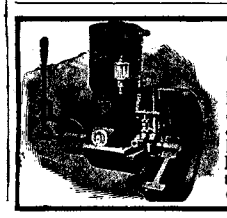

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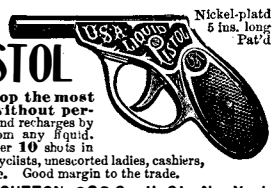

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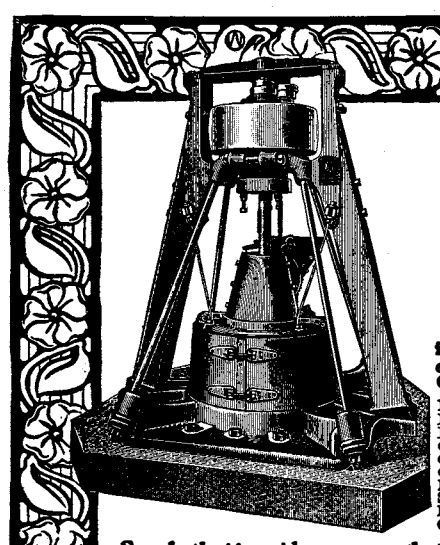

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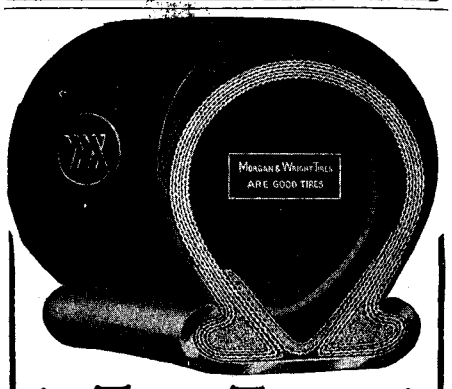

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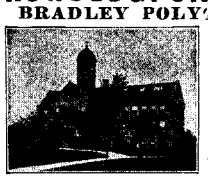

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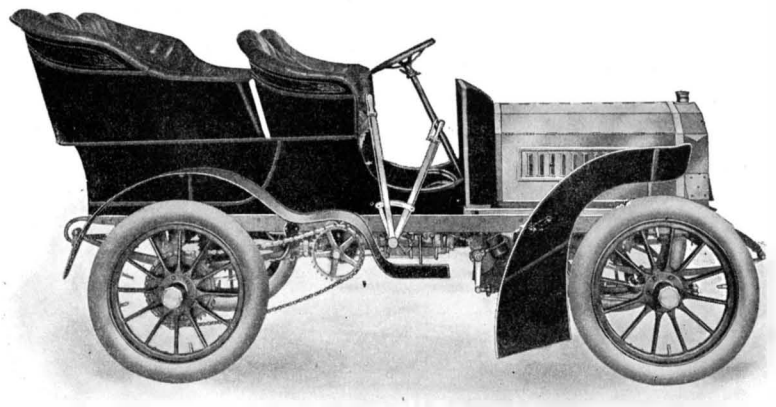

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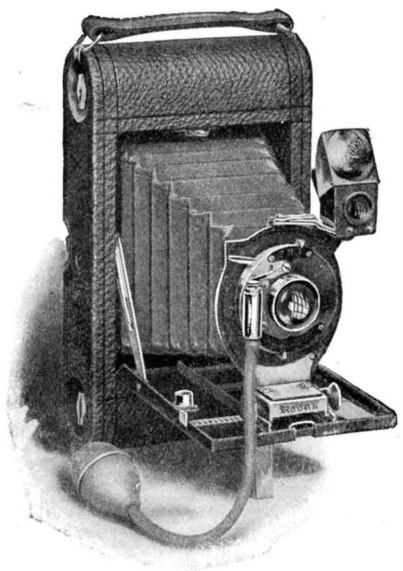

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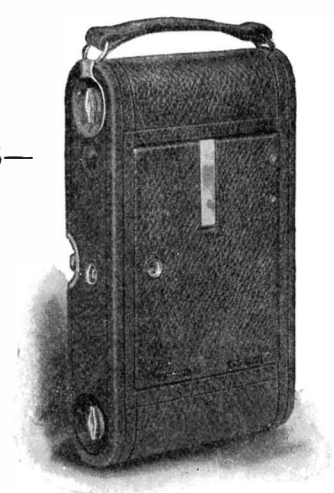

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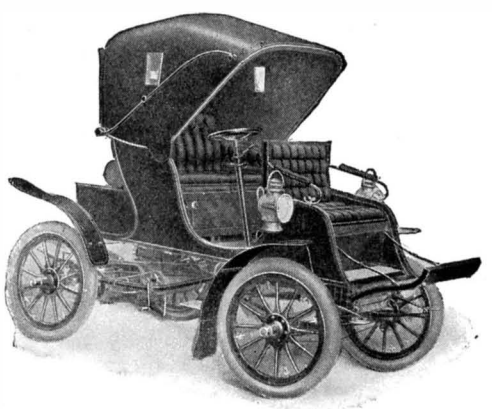

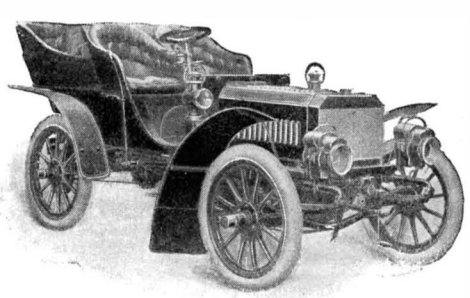

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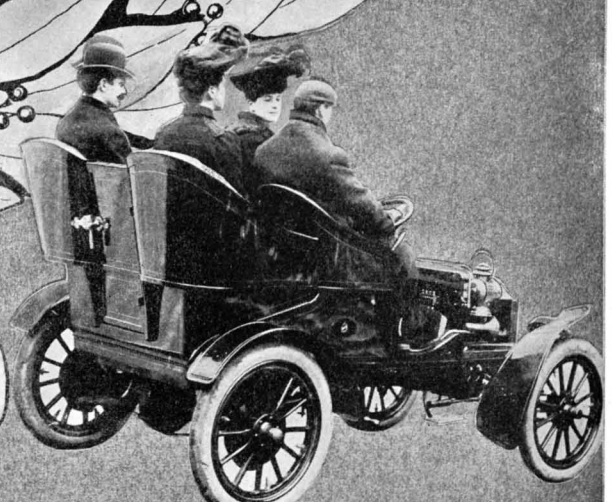

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